The Unesco Courier

MARCH 1982 - 5 French francs

SWORDS INTO PLOWSHARES

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TREASURES OF WORLD ART

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Japan

The angel of Nagasaki

This stone carving of an angel is from the Japanese city of Nagasaki, which was destroyed by an atomic bomb on 9 August 1945. It originally formed part of the façade of the Roman Catholic church of Urakami, above which the bomb exploded. In 1976 the angel was presented to Unesco by the city of Nagasaki and is today preserved, as a symbol of mankind's desire for world peace, in the Japanese garden at Unesco's Paris Headquarters.

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Cover design Louis Briat
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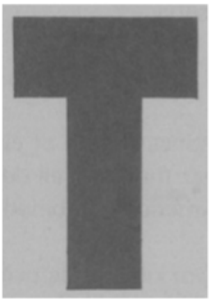
This issue of the *Unesco Courier* goes to press at a time when the arms race continues to gather momentum like a juggernaut, engulfing in a seemingly bottomless pit resources that are desperately needed for social and economic development. It is largely devoted to an examination of the disarmament issue in relation to development and the establishment of a new international economic order; to a review of the human and material resources today being used for military purposes; and to a survey of the problems involved in converting these resources to the production of goods and services that can contribute to development—the beating of swords into plowshares that is symbolized by our cover. Contents of our next issue will include articles on the city of Kiev, which is this year celebrating the 1,500th anniversary of its foundation; on the life and work of the great Irish novelist James Joyce; and on the flowering of Arabic poetry in Muslim Spain. The theme for May will be Charles Darwin and the theory of evolution.

A WORLD OF JUSTICE PEACE AND PROGRESS

by Amadou-Mahtar M'Bow
Director General of Unesco



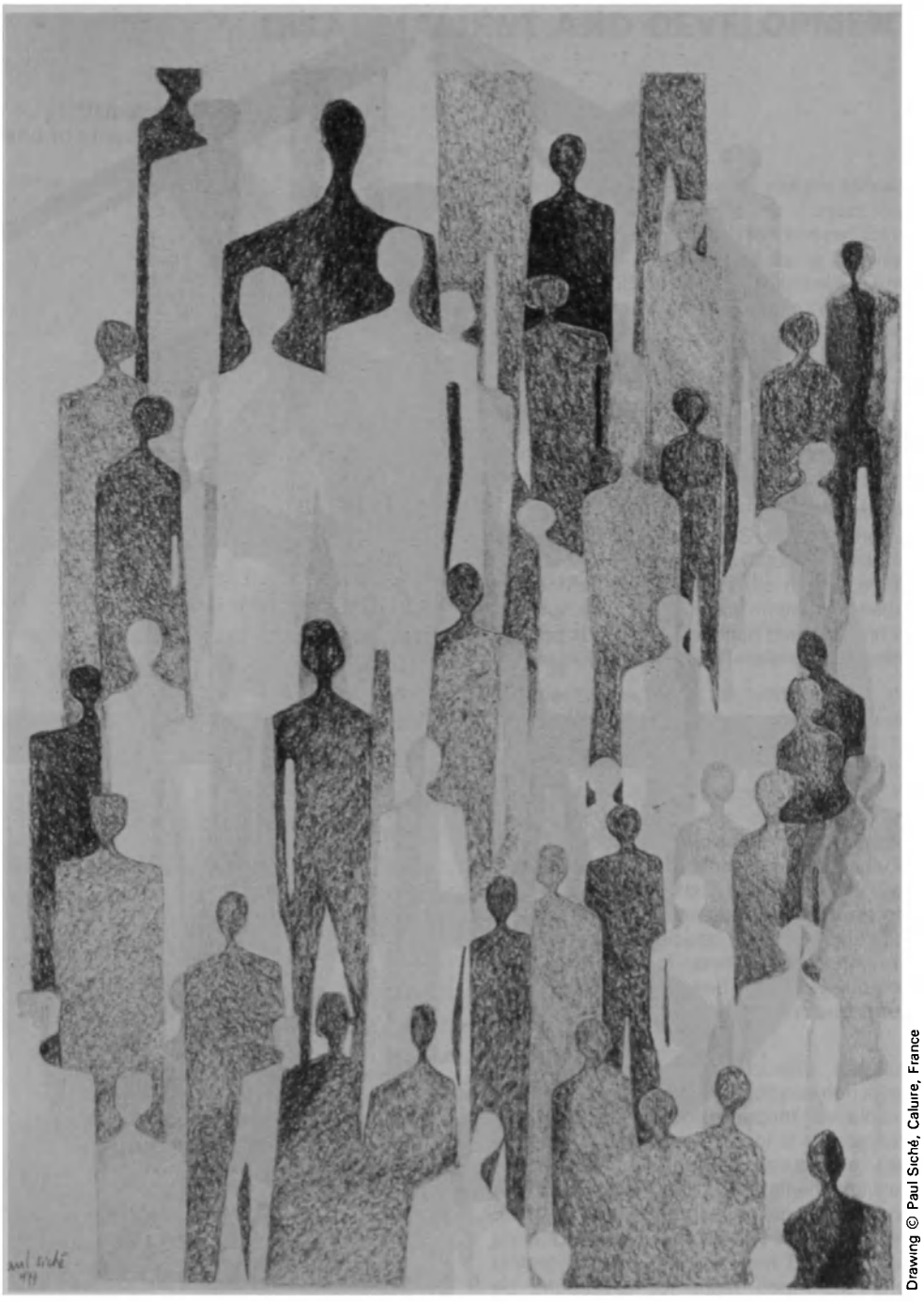
HE effort to build a world of justice, peace and progress for all peoples is hindered by the proliferation of ever more sophisticated means of mass destruction. The consequences of this situation are alarming for two reasons. First, the threat of an unprecedented hecatomb hangs over the entire world and, as atomic radiation knows no frontiers, there is not a single country or people today that is secure from the effects of a major nuclear conflict.

Secondly, the vast human and material resources allocated to arms industries and military research and development are thereby denied to those who are engaged in the world struggle against the poverty which afflicts so many people. The talents and energies of 500,000 engineers and research workers are being used to perfect the technology of death and thousands of millions of dollars are invested every year for that purpose. A mere fraction of these intellectual, financial and technological means, if used judiciously, would suffice to reverse the present trends and make it possible to start reducing the gap between industrialized nations and developing nations, as well as between privileged groups and underprivileged groups within each nation. This might even alter the physiognomy of our planet.

The choice before us is therefore crystal clear. Either we carry on the arms race with all its attendant injustices, and this perpetuates egoistic attitudes and contributes, in its turn, to increasing the causes of conflict and the risk of conflagration, or the nations of the world unite, placing their awareness of a shared future above their short-term ambitions and individual interests. The tremendous scientific and technological potential of the world could then be used more often to serve peaceful ends, promote the common welfare of mankind and help to forge relations based on justice and a sense of solidarity.

It is with this end in view that Unesco, true to the mission of the United Nations system, is expanding its activities in all spheres of intellectual effort. Its Constitution proclaims that "since wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed". The Organization is accordingly doing all in its power to help to prepare the way for disarmament in people's minds, to bring about a gradual change in mental attitudes so that more thought is given to the pursuit of peace.

In this issue of the Unesco Courier *we present long extracts from an important new report of the Secretary-General of the United Nations entitled "Study on the Relationship between Disarmament and Development". The report, prepared by 27 governmental experts from the different world regions, originated in a request to the Secretary-General by the General Assembly at its Tenth Special Session in June 1978. It represents a major attempt by the international community to investigate the proposition that a balanced and generally accepted pattern of global economic and social development is inextricably related to disarmament. With the present issue we complete a three-part examination of problems related to disarmament: our April 1979 number drew attention to the growing momentum of the arms race, and in September 1980 we traced the emergence of education in favour of disarmament as a distinct field of study.*



Drawing © Paul Sicré, Calure, France

DISARMAMENT AND DEVELOPMENT
The greatest challenge of the century

MANKIND is at present facing the greatest challenge of the century. The level and speed of the arms race are bound to increase the danger of war. The outbreak of a nuclear war would jeopardize the very existence of all mankind. During this decade peoples will be confronted with new technological, economic and social challenges that will be made far more complex if the arms race continues unabated. In the context of halting and reversing this race, it is also imperative to find solutions to the problems impeding the technological, economic and social development of the developing countries. Additional human, material and financial resources are needed to solve the problems in such fields as raw materials, energy, food production and environmental protection. The challenges of the 1980s urgently call for real and effective disarmament measures in the interests of mankind.

The phenomena described by the terms *disarmament* and *development* are widely▶

Photo United Nations, New York

"Disarmament is the process of reduction in the size of and expenditures on armed forces, the destruction or dismantling of weapons, whether deployed or stockpiled, the progressive elimination of the capacity to produce new weapons and the release and integration into civilian life of military personnel. The ultimate objective is general and complete disarmament under effective international control."

▶understood in general terms but it is worthwhile to be somewhat more specific. Disarmament is the process of reduction in the size of and expenditures on armed forces; the destruction or dismantling of weapons, whether deployed or stockpiled, the progressive elimination of the capacity to produce new weapons and the release and integration into civilian life of military personnel. The ultimate objective is general and complete disarmament under effective international control.

The intervening process must be characterized by balanced reductions that ensure undiminished security for all States and provide for the adequate verification of compliance with agreed-upon reductions. There is a clear place in this process for arms limitation agreements that genuinely restrain the quantitative growth and qualitative refinement of arsenals, particularly as such agreements would be invaluable as confidence-building measures and serve as stepping stones to actual reductions.

Similarly, in addition to a global process of disarmament there is scope for unilateral initiatives at the national level and for regional arrangements, although there will be distinct limits beyond which initiatives at these lower levels could not proceed. While it is difficult to predict the course that a disarmament process would follow, it is clear that, particularly in the initial stages, the reductions agreed upon will be modest and that ample time will be allowed to achieve them.

Development, in its broadest sense, refers to social and economic changes in society leading to improvement in the quality of life for all. At the most fundamental level, it means providing for every person the basic material requirements for a productive and dignified existence. Economic growth, that is, the expansion of output, is a prerequisite for sustained development but development cannot be reduced to economic growth. Development also means that everyone should have the opportunity to participate

"...Everyone should have the opportunity to participate fully in the economic and social process and to share in its benefits."

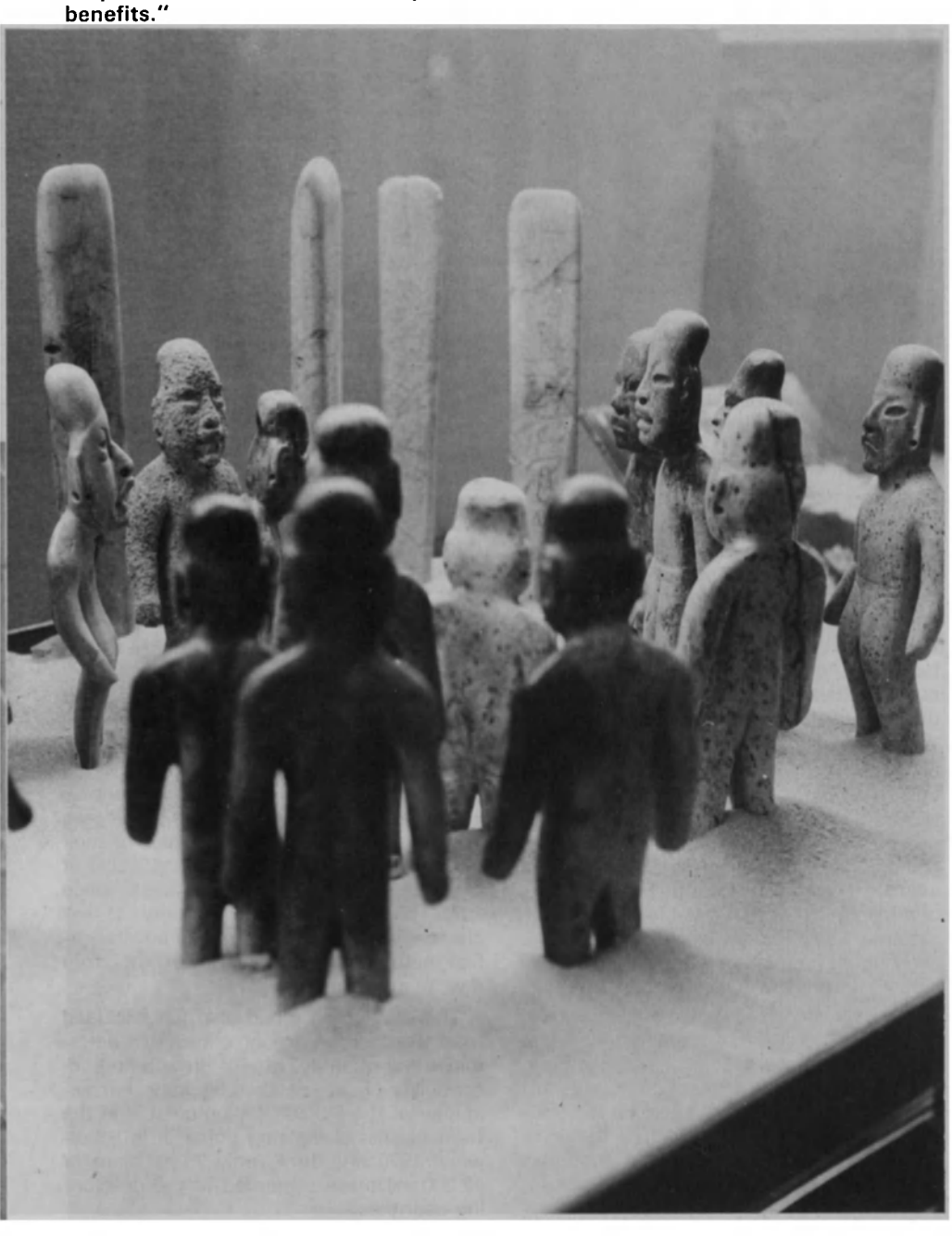


Photo © Roger-Viollet, Paris

fully in the economic and social process and to share in its benefits.

If the global development effort is to be morally and politically sustainable, it must endeavour to provide for a pattern of economic growth that would significantly diminish within a reasonable time the prevailing disparities between States in the quality of life. It should also be demonstrably compatible with long-term resource availabilities and environmental constraints, insofar as it is possible to determine these limits.

Now one of the more attractive traits of the human character is the deep-seated sense of unease felt by those who are prosperous when confronted by those who are not just less prosperous but quite simply poor.

It is true that history is overwhelmingly the record of the rich endeavouring to sustain a state of ignorance, of insulating themselves from the fact of poverty, but this, clearly, is an expression of the moral dilemma posed by inequality. At the international level, revolutionary developments in transportation and communication have made the world a very small place. The gap between rich and poor nations has become steadily more apparent and, therefore, more difficult to ignore or deny. In a remarkably swift reversal of political climate, the issue of greater equality between the peoples of various nations has been widely proclaimed as the principal moral imperative of our time.

To its credit, the international community has already taken an important step toward confronting the problem of international co-operation for mutual benefit and the difficulties and potential opportunities that this problem presents. The sixth special session of the United Nations General Assembly in April-May 1974 adopted the Declaration and the Programme of Action on the New International Economic Order.

The Programme was designed to lead to the establishment of an international economic order that would redress existing injustices and thus help to correct inequalities and bring about a marked reduction in the gap in standards of living between developed and developing countries. Other important steps that built on this initiative include the Charter of Economic Rights and Duties of States, the seventh special session of the General Assembly devoted to development and international economic co-operation and the International Development Strategy for the Third United Nations Development Decade.

There were, and remain, significant differences among Member States on whether the new order would require a radical transformation or merely the reform of the existing one, on the policy measures needed to bring about the described changes and on how rapidly it would be feasible to proceed.

Nevertheless, the Declaration and the Programme of Action were adopted by consensus, reflecting the growing awareness on all sides that the interests of the developing countries and developed countries could no longer be isolated from each other. The prosperity of the international community as a whole depends upon the prosperity of its constituent parts. The necessity was recognized of eliminating the widening gap between the developed and the developing countries and of ensuring steadily accelerating economic and social development in peace and justice for present and future generations.

This challenge to inequality gathered force as the process of decolonization swelled the ranks of independent developing countries and as the majority of these countries felt increasingly frustrated in their development efforts. Sustained achievement of growth targets set in the International Development Strategy for the Second United Nations Development Decade proved impossible for most countries. Their terms of trade continued to move adversely, agricultural production remained uncertain, the trade deficits of developing countries in manufactured goods grew rapidly, and official development assistance, on the whole, remained well below the target of 0.7 per cent of the GNP of donor countries.

The share of developing countries in world exports of manufactured goods was increasing very slowly but this expansion was distributed very unequally. Indeed, by 1977, just eight countries and territories (Brazil, Hong Kong, Malaysia, Mexico, the Philippines, Singapore, South Korea and Taiwan) accounted for almost 75 per cent of the total exports of manufactured goods by the developing countries.

Moreover, whether a developing country pursued industrialization through a policy of import-substitution or export promotion, the almost universal experience was the creation of industrial enclaves employing a small fraction of the work-force in relative prosperity. Large segments of the population, often the majority, neither participated in nor benefited from economic growth.

The World Bank estimates that, for the developing countries as a whole, the ex- ▶

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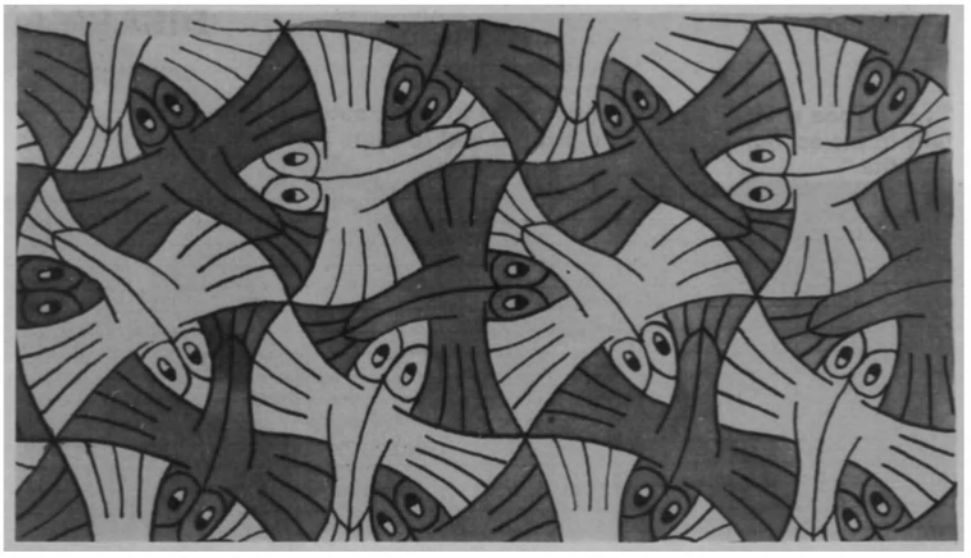


Engraving by M. C. Escher
Photo © Gemcente Museum, The Hague

▶perience has been that approximately 75 per cent of the increase in aggregate income accrues to the top 40 per cent of income recipients. The ranks of the unemployed and the underemployed and those living in absolute poverty have swelled inexorably.

These frustrations were compounded by the evidence that, within the existing international economic order, no plausible projections of the rate of economic growth in the developing countries would have any appreciable impact on the gap in *per capita* income.

In 1975, average *per capita* income in the developing countries was just one twelfth of that in the developed economies. The developing countries, however, are a quite heterogeneous group, even excluding the oil-exporting countries. In 1975, the gap in *per capita* income ranged from a massive 40:1 for the very low income countries of Asia and Africa to a little over 5:1 for the Latin American and Caribbean countries.

According to the World Bank, even quite optimistic projections of economic performance until 1990 would not diminish the overall gap in *per capita* income. A narrowing of the gap in some countries, particularly in East Asia and the Pacific, would be offset by widening differential in the countries of Asia, Africa, the Middle East and Latin America.

In the initial statement on the establishment of the new international economic order, considerable emphasis was placed on stabilizing and increasing the level of export earnings in developing countries. For raw materials and primary commodities, the principal measures suggested were price-stabilization funds, buffer stocks and a form of indexation to the prices of manufactured goods imported from the developed countries. For the manufactured exports of developing countries, stress was placed on preferential access to markets in developed countries.

Industrialization of the developing countries was recognized as a necessary and vital component of the new international economic order and developed countries and multinational institutions were encouraged to adopt policies to accelerate the transfer of labour-intensive, raw-material processing and export-oriented production to the developing countries. At the Second General Conference of the United Nations Industrial Development Organization (UNIDO) held in Peru in March 1975, it was declared that the target should be to increase the share of the developing countries in world industrial production to at least 25 per cent by the year 2000 from the then prevailing figure of about 7 per cent.

The proposal for a new international economic order also addressed the question of the transfer of technology. Technological developments have made and will certainly continue to make very significant contributions to economic growth in all countries. However, modern industrial technology is concentrated almost exclusively in the industrialized and developed countries.

Developing countries have not only become greatly dependent on the flow of technology, capital goods and technical services from the developed countries, but the gap between the two groups in indigenous technological capability has tended to become increasingly accentuated. This state of affairs has tended inevitably to produce a pattern of technological development and a consequent industrial structure that closely follows that of the industrialized countries.

However, there are growing misgivings in developing countries, including those that have been most successful in industrializing, as to whether this pattern of development is really suited to meet their particular socio-economic needs. Accordingly, the proposals in the new international economic order on this issue stress the need for developing countries to have continued access to modern technology on improved terms, to have this technology adapted to their specific economic, social and ecological conditions, and for measures to expand their research and development capabilities, particularly by means of greater assistance from the developed nations.

On a closely-related theme, the proposal for a new international economic order suggested that all efforts should be made to formulate, adopt and implement an international code of conduct for transnational corporations to ensure that the activities of these corporations conform to national development plans and to encourage them to contribute to the new international economic order by transferring technology and managerial skills to developing countries on favourable terms and to reinvest rather than repatriate profits. Also of significance in this overall context is the work on an international code of transfer of technology carried out in the United Nations Conference on Trade and Development (UNCTAD).

The developing countries sought a larger and more effective voice in international financial forums, particularly the International Monetary Fund (IMF) and the World Bank. Inflation in the developed countries increased the import bill for developing countries and eroded the real value of their currency reserves. The general instability of the international monetary system since 1971, particularly the uncertainty of exchange rates, frequently had an adverse effect on the value of commodity exports from developing countries.

The developing world also felt excluded from the decision-making circles that determined the quantity, rate of growth and accessibility of international liquidity. For example, of the $ 9,300 million created in the form of special drawing rights in IMF between 1970 and 1974, only 25 per cent or $2,300 million was granted to the developing countries.

Finally, the developing countries argued the need for a more conciliatory attitude in the developed countries regarding the repayment and servicing of external debt. A combination of circumstances in the 1970s—large increases in the price of oil, stagnating markets in the developed countries for exports from the Third World and inadequate official development assistance—led to a disturbingly fast rate of increase in the external indebtedness of many developing countries. By 1977, nearly 12 per cent of the export earnings of the▶

"Inflation in the developed countries has increased the import bill for developing countries and eroded the real value of their currency reserves. The general instability of the international monetary system has frequently had an adverse effect on the value of commodity exports from developing countries. The developing world has also felt excluded from the decision-making circles."

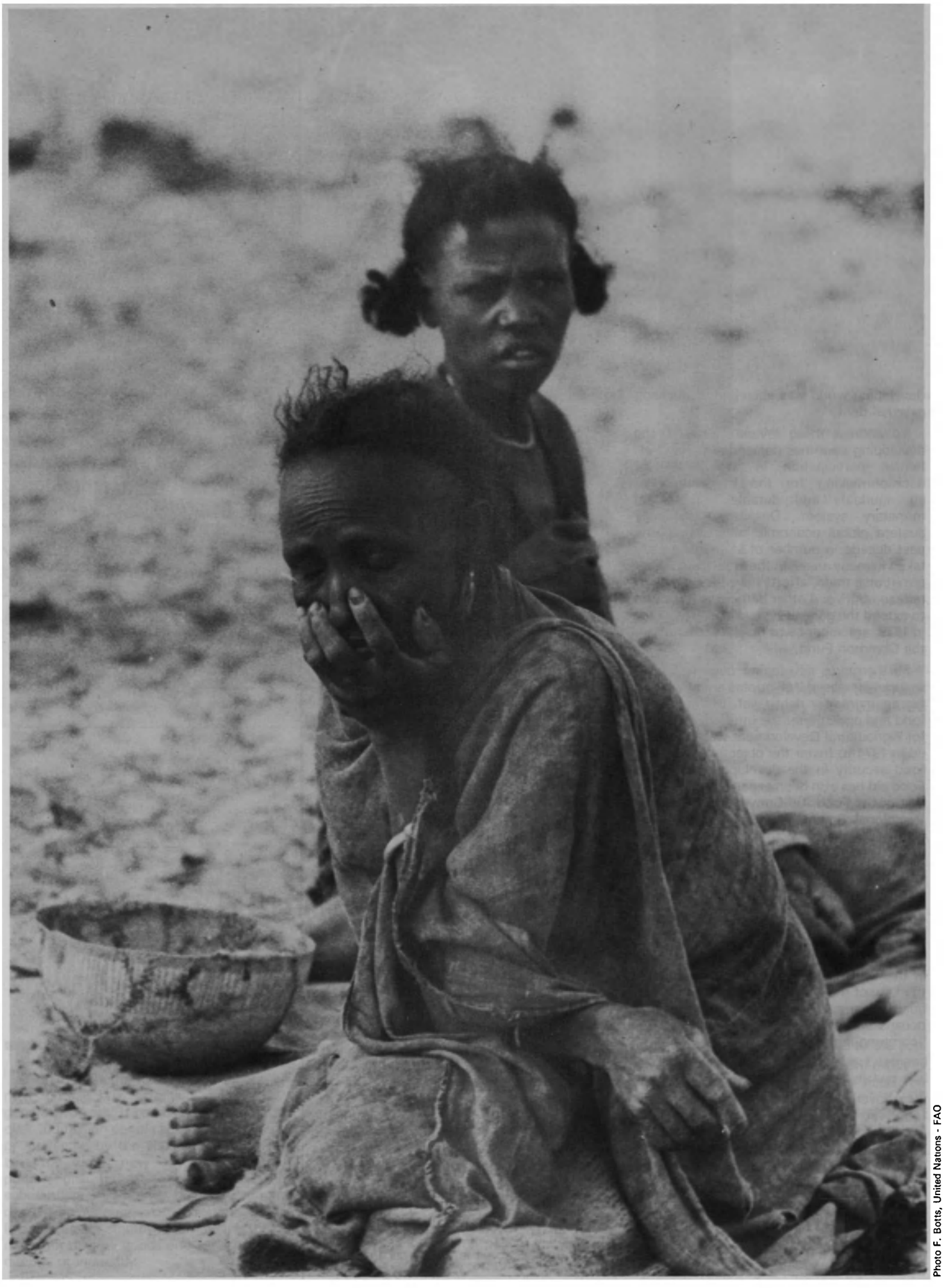


Photo F. Botts, United Nations - FAO

developing world was absorbed in servicing external debt.

To address these several concerns, the developing countries demanded full and effective participation in all phases of decision-making for the formulation of an equitable and durable international monetary system. Despite a generally austere global economic climate over the past decade, a number of steps have been taken in many areas. In the crucial area of international trade, efforts have been made to reduce tariffs and other barriers to trade and to extend the general system of preferences. In 1979, agreement was reached to establish the Common Fund.

Furthermore, developing countries have secured increased IMF quotas and improved arrangements for debt relief. In the field of food and agriculture, the International Fund for Agricultural Development was established in 1974 to foster the objective of greater food security in the developing countries. Food aid has also been expanded in the context of the Food Aid Convention and an International Emergency Food Reserve has been established with a target—as yet unmet—of 500,000 tons of cereals.

In 1980, an Interim Fund for Science and Technology for Development was established, and the General Assembly initiated a programme of study to investigate appropriate longer-term arrangements. Finally, mention should be made of the negotiations in the Third United Nations Conference on the Law of the Sea, where the principle has been accepted that the resources of the oceans and of the sea-bed are part of the "common heritage" of mankind.

While these and other measures that have not been mentioned are important beginings, overall progress towards laying the foundations of a new international economic order has been slow. The goals and objectives of the Second Development Decade remain largely unfulfilled and the necessarily ambitious targets for the Third United Nations Development Decade are indicative of the magnitude of the task ahead.

Primary responsibility for development rests with the developing countries themselves, but the targets for the Third Development Decade and the longer-range objective of significantly reducing the gap in standards of living are quite unfeasible without the strong assistance and co-operation of the developed countries. Similarly, the deepening of co-operation and the expansion of economic relations among developing countries, both bilaterally and multilaterally, will play an important role in bridging this gap.

The call for a new international economic order was in every sense a historic initiative. It both reflected and took advantage of the fact of interdependence to articulate the reforms and changes needed to permit the developing countries to become full and constructive participants in the global economic system on an accelerated basis. It was, in effect, a plan of action for the co-operative management of interdependence, albeit for an extended interim period, for the particular benefit of the developing countries.

Since 1974, it has become progressively more apparent that a comprehensive assault on underdevelopment is strongly in the self-interest of the industrialized countries. Since the new international economic order was couched in the context of economic relations among all groups of States, the phenomena of interdependence and the expansion of economic co-operation based on mutual interest now embrace international economic relations as a whole.

Altogether, sustainable global development is heavily dependent on what has been termed the co-operative management of interdependence in its political, economic and physical dimensions. It only remains to ask whether such a perspective will emerge and endure if the arms race continues unabated. And the answer, surely, is no. Indeed, the political climate accompanying the arms race would appear to be the very antithesis of a genuine and enduring spirit of co-operation and mutual accommodation.

The co-operative management of interdependence may be eminently sensible, perhaps even necessary, for the realization of global economic and social aspirations but such a prospect must be regarded as rather unrealistic as long as the arms race continues. ■

THE SINEWS OF WAR

In the following section we take a look at current use, for military purposes, of labour (including the scientific community), industrial capacity, raw materials and land. We also examine two other dimensions of the military scene: military research and development, and military expenditures.

Photo © Rijksprenten Kabinet, Amsterdam

Sleeping Mars, **an engraving by the 17th-century artist Jacob de Gheyn III.**

1
MANPOWER

50 million people employed in meeting the demand for military goods and services

TENS of millions of persons around the world are engaged in military activities, whether as soldiers, sailors, airmen, bureaucrats, scientists, engineers or general workers. It has been estimated that over 100 million people are affected, directly or indirectly, by the $500 thousand million that the world now devotes to military preparations. It has not been possible to substantiate this figure, but the estimates derived below suggest that roughly 50 million people are employed in meeting the demand for military goods and services, either directly or indirectly.

Even this latter figure covers categories of labour that differ in the manner and the degree to which they depend on military outlays. For our purposes it is useful to distinguish between five categories of demand for labour that can be said to be generated or supported by military expenditures:

a) The labour force, including uniformed military personnel, engaged directly by defence ministries to render services or to provide goods and services that are exclusively military in character, that is, goods and services that for all practical purposes have no civilian utility whatever;

b) The labour force engaged in supplying intermediate goods and services to the concerns engaged in meeting the direct demand from ministries of defence for finished and specialized military goods and services. This indirect employment supported by military expenditures relates to employment by subcontractors, by firms supplying the subcontractors and so on. There will clearly be at this level a lingering degree of specialization for military work, but this would diminish sharply as one moved down the manufacturing chain;

c) The labour force in manufacturing and service industries engaged in meeting the direct demand from ministries of defence for ▶

▶goods and services that are little different from those of the civilian market;

d) The labour force engaged in supplying intermediate goods to the concerns under (c), that is, a second category of labour services supported indirectly by military expenditures;

e) The labour force stemming from the multiplier concept, which is quite distinct from the other four categories. All expenditure, including military expenditure, is subject to a multiplier effect that permeates throughout the economy. If, say, the multiplier in a particular country is estimated to be two, expenditure of $10 thousand million will ultimately result in a total increment in effective demand of $20 thousand million.

Provided the economy is not already at full employment, this means that, in addition to the workers directly or indirectly involved in the provision of defence goods and services, more jobs will be created as the defence expenditure ripples through the economy. Unlike the other categories of defence-related employment referred to above, however, these jobs cannot be said to be "absorbed" by the defence sector.

The labour force directly engaged in activities that have no civilian economic utility (category [a] above) includes the regular armed forces and those paramilitary forces that have similar functions and capabilities, civilians employed in defence ministries, scientists and engineers engaged in military research and development and the workers in industry directly engaged in the production of weapons and other specialized military hardware.

At the present time, the world's regular armed forces total some 25 million persons. This figure has risen steadily over the past twenty years, with net stability among the developed countries accompanied by increases in many developing countries. The global figure in 1980 was more than 10 per cent larger than in 1970 and nearly 30 per cent larger than in 1960. The countries of the North Atlantic Treaty Organization (NATO) and the Warsaw Treaty Organization (WTO) account for slightly over 40 per cent of the total, China for about 17 per cent and the developing countries of Asia, Africa and Latin America for about 38 per cent.

Although it cannot be documented statistically, it is important to observe that the range of skills and experience in the regular armed forces is very wide. A disproportionately large fraction would consist of able-bodied young men with, at best, a high-school education and possessed only of basic skills in the handling of infantry weapons. At the same time, however, there would be significant numbers—running into millions world wide—of mechanics, technicians, engineers, pilots and those with experience in organization and management. Indeed, the military's rising demand for skilled personnel of all kinds is a universally observed phenomenon.

Paramilitary forces are forces whose functions and duties fall somewhere between the civilian police and the regular armed forces. The number of persons in paramilitary forces with functions and capabilities—in terms of training, organization and equipment—that approximate to those of the regular armed forces is estimated by the International Institute for Strategic Studies to be roughly 10 million world wide.

By and large, expenditures for paramilitary forces are not included in reported military budgets. They remain relevant in the present context because it is reasonable to assume that an international climate that made possible the implementation of disarmament measures would also permit reductions in paramilitary forces. Indeed, disarmament measures may require such reductions.

The data available on civilians employed in defence departments are far from complete, but a very rough global estimate can be constructed as follows. In 1975, nine countries—Australia, Canada, the Federal Republic of Germany, France, Japan, the Netherlands, the United Kingdom, the United States of America, and the Union of Soviet Socialist Republics—employed some 2.5 million civilians in their respective defence departments.

These nine countries accounted for two thirds of world military expenditure, so that, assuming a linear relationship and making a small upward adjustment for the subsequent growth in the size and cost of the world's armed forces, it can be estimated that approximately four million civilians are currently employed in defence departments world wide.

The scientists and engineers engaged in military research and development (R and D) are of particular importance both in military terms and in terms of economic and social consequences. This subject is discussed more fully below, and here it may simply be noted that, world wide, an estimated 500,000 scientists and engineers are engaged in research and development for military purposes.

Thus far we have identified 39.5 million persons directly engaged in purely military activities, but the statement that this workforce is totally unproductive from the civilian standpoint must be qualified somewhat. The armed forces are frequently called upon for disaster relief operations, for example. In many countries the armed forces also engage in certain civilian activities. Similarly, a fraction of military R and D is basic research with potential civilian utility, provided, of course, the work is not classified as secret. Similarly, there is always the possibility that specialized military research and development may yield some civilian spin-offs. However, these qualifications do not alter the general significance of the fact that important human resources are being used for military purposes.

The final body of labour relevant to category (a), workers directly engaged in the production of weapons and other specialized military equipment, is perhaps the most difficult of all to estimate reliably.

Most of the available information on defence-related employment does not clearly distinguish between direct and indirect employment nor between specialized and non-specialized output. On balance it would seem that *direct industrial* employment associated with the supply of specialized military equipment world wide is about four million.

The *global* estimate of the labour force directly employed by the military for the supply of goods and services of a specialized character—including services provided by uniformed military personnel—is therefore about 43.5 million. This is the size of the labour force that has to be redeployed to economically productive work and is of immediate concern in the context of disarmament and the associated requirements for conversion.

To this figure must be added the number of workers in the other four categories of defence-related employment mentioned above. With regard to direct employment associated with military purchases of civilian goods and services, the data for the United Kingdom show this to be about 50 per cent of the direct employment from specialized demand. Crudely extrapolating this relationship suggests a global figure of about two million.

Industrial employment sustained indirectly by military purchases is probably 50 to 100 per cent as large as direct employment. Taking a crude estimate of six million for total direct industrial employment world wide it follows that there are an additional three to six million industrial jobs indirectly supported by military expenditure. It should be stressed again that the output associated with this indirect employment will predominantly be directed, in the event of disarmament, toward civilian markets that would be expanding under the impetus of compensatory programmes. ■

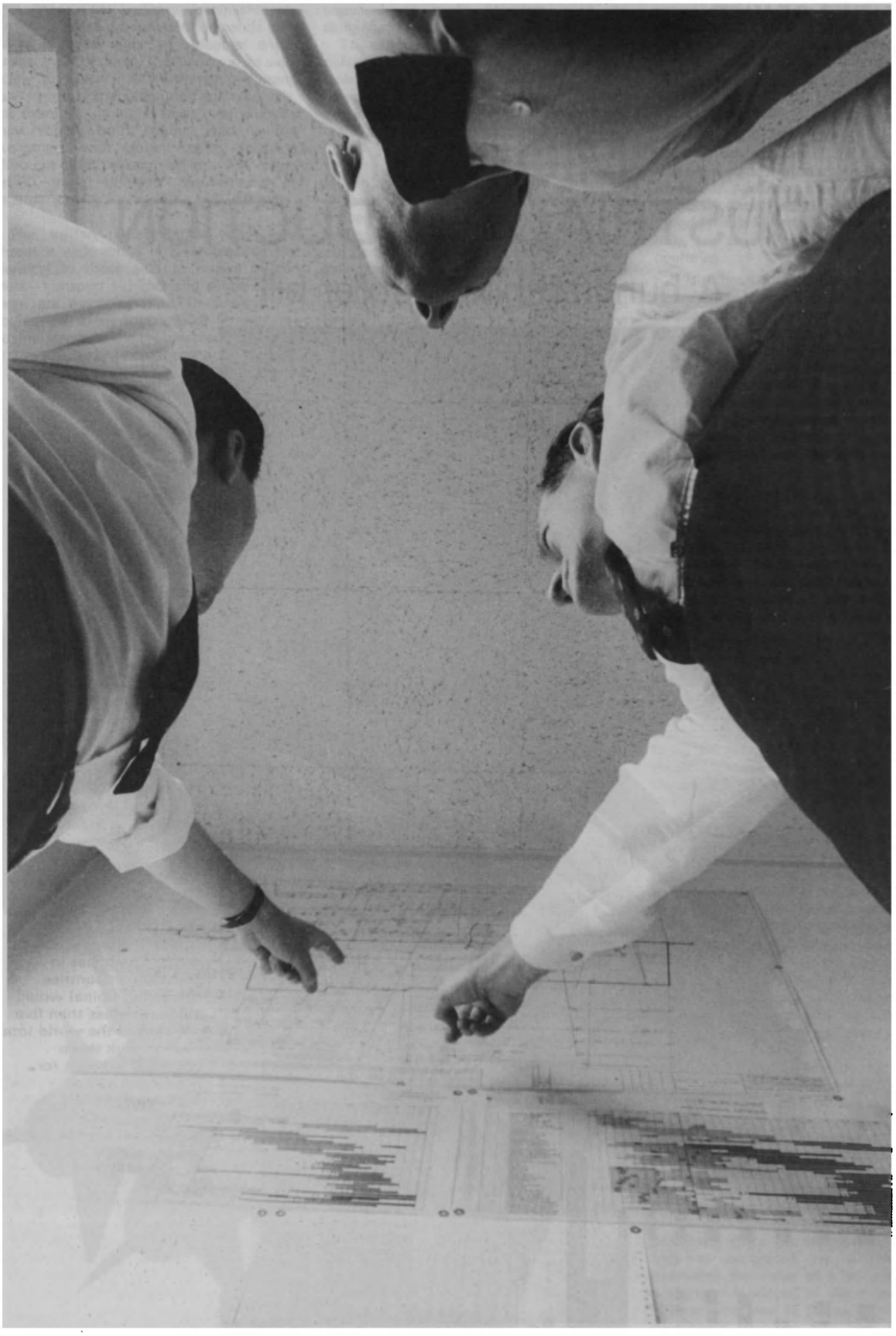
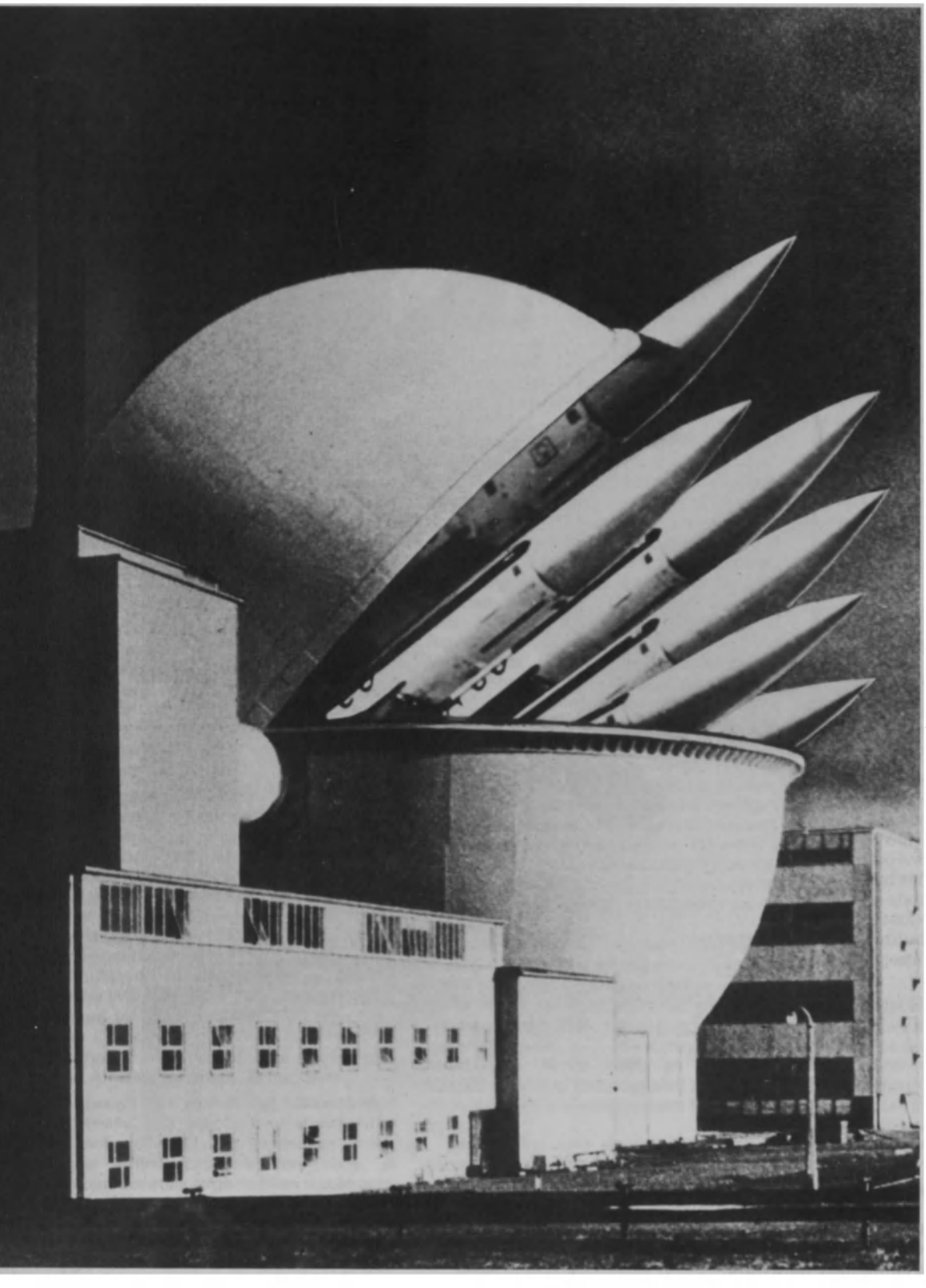


Photo © Jacques Windenberger, Aix-en-Provence

"The labour force directly engaged in activities that have no civilian economic utility includes the regular armed forces and certain paramilitary forces (...), civilians employed in defence ministries, scientists and engineers engaged in military research and development and the workers in industry directly engaged in the production of weapons and other specialized military hardware."

2
MILITARY INDUSTRIAL PRODUCTION

A hundred billion dollar bill



"Industrial production for military purposes in developing countries (excluding China) would amount to less than five per cent of the world total even though these countries account for nearly one half of uniformed military personnel and about sixteen per cent of the world military expenditure."

MODERN military establishments place procurement demands on a wide range of industrial enterprises. In some cases, these enterprises exist solely to satisfy military demand—forging tank turrets or manufacturing artillery shells, for example. In other cases, the industry may supply both military and civilian customers with quite similar products although the military variant will often reflect more stringent requirements as regards quality, precision and reliability.

The military establishment also purchases a wide range of products that are identical to those sold to civilian customers—transport vehicles and office equipment are examples here. In addition, of course, all these suppliers of finished industrial goods to the military place demands on the suppliers of components down to the suppliers of basic products such as aluminium, steel and plastic.

To estimate the magnitude of global military industrial production is no simple task. A logical starting point is the budget category "procurement" which is broken out in the official statistics of most of the major arms-producing countries. In the major Western arms-producing countries the share of procurement in the military budget falls in the range of 13 to 22 per cent.

These data, however, tend to refer to purchases of major equipment and considerably understate the value of manufacturing output generated by military demand. The major omissions would appear to be production to meet export orders, components and spare parts and the wide variety of industrial products that are used or consumed by the military but are otherwise indistinguishable from civil products. In the United States, for example, the amounts for procurement in the military budget for 1975 and 1976 were $15,200 million and $16,000 million respectively, while shipments of defence products by manufacturing industry in those years amounted to $29,210 million and $34,000 million respectively.

For the years 1976-1977, it is possible to document an estimate of $95,500 million for military industrial production in the United States of America, the Union of Soviet Socialist Republics, France, the United Kingdom, the Federal Republic of Germany, Italy, and seven smaller Western European countries.

It is difficult to assess by how much this figure should be inflated to yield a global estimate. On the one hand, many countries with substantial local defence production are omitted, including China, Japan, Czechoslovakia, Israel, India and Brazil. On the other hand, the figure cited would, on the whole, include production for export, and the four major Powers covered by the estimates account for the lion's share of the international trade in arms. In other words, to take, say, a 20 per cent share of the combined military expenditure of the rest of the world as an estimate of military industrial production may imply considerable double counting.

Nevertheless, an estimate of $105,000 million for global military industrial production in 1976-1977 would appear quite plausible, indeed, conservative. If one takes the Stockholm International Peace Research Institute (SIPRI) and the United States Arms Control and Disarmament Agency (ACDA) estimates of China's military expenditure—$35 thousand million to $40 thousand million in 1976—the military industrial production in that country alone would bring the global estimate close to $105,000 million. And there are many other countries known to have a significant military industrial capacity.

The estimate of $105,000 million represents 30 per cent of world military expenditure in 1976. This is plausible as a global figure, bearing in mind that military industrial production is a much broader activity than the procurement of major weapons. However, to reflect the incompleteness of the data and the contradictory influences to which the estimate is subject, it would seem sensible to use a range of 28 to 32 per cent of world military expenditure as an estimate of the value of industrial production given over to military use.

These estimates reflect the fact that the overwhelming bulk of military industrial production is undertaken by the industrialized countries. Industrial production for military purposes in developing countries (excluding China) would amount to less than 5 per cent of the world total even though these countries account for nearly one half of uniformed military personnel and about 16 per cent of the world military expenditure. This approximate share for the developing countries is supported by ACDA, which estimated the value of arms and military equipment produced in these countries in 1979 at more than $5 thousand million. The developing countries that have made the most significant investment in defence industries include Brazil, India, Israel, North Korea, South Africa and South Korea. Many other countries are making smaller but determined efforts in this field. ■

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3
RAW MATERIALS

Global military consumption of aluminium, copper, nickel and platinum is greater than overall demand for these minerals in Africa, Asia and Latin America combined

ONE of the most striking developments of the 1970s was the emergence of serious concern over the availability of adequate supplies of oil and minerals, that is non-renewable raw materials for the support of human life and modern industry. Concern over supply has come to rival the traditional focus on effective demand as the key factor constraining growth.

For the immediate future, the problem is seen in terms of security of access to supplies of raw materials, not the exhaustion of supplies *per se*. All calculations and projections indicate that there are ample materials available in the earth's crust to meet the world's needs for nearly every material through the end of this century.

On the other hand, the end of this century is less than twenty years away, so that real natural scarcities are not such a distant prospect unless one is prepared to assume that timely discoveries of major new reserves will be made, and that these resources can be exploited technically and economically.

There is considerable geographic concentration of the world's reserves of oil and minerals: for more than a dozen industrially important minerals the share of the three largest reserve countries exceeds 50 per cent. The significance of this becomes apparent when it is coupled with the fact that the consumption of minerals is even more highly concentrated geographically: the industrialized market economies—essentially North America, Western Europe and Japan—consume more than two thirds of the annual production of the nine leading minerals. Consumption in the industrialized Socialist countries is in the range of 20 to 25 per cent of the world total for most minerals. The developing countries of Africa, Latin America and Asia (including China) used only 7 per cent of the world's aluminium production in the period 1971-1975, 9 per cent of the copper and 12 per cent of the iron ore.

The major consuming nations have, as a result, experienced a significant decline in the degree of self-sufficiency in minerals. The United States, for example, in 1950, relied on imports for more than 50 per cent of its requirements for just four industrially important minerals: by 1976 the list had grown to twenty-three minerals. Indeed, for at least twelve minerals, United States dependence on imports currently exceeds 80 per cent. Import dependence is even more acute in the European Economic Community and in Japan, where imports provide 75 per cent or more of such critical minerals as iron ore, nickel, copper, bauxite, chromium, asbestos, manganese, cobalt, zinc, lead and silver.

The anxiety over growing dependence on imported minerals stems primarily from the impact that a disruption of supplies would have on the general economic health of the consuming nation. Another major concern, however, is the effects of this situation on a nation's ability to wage war. There are several dimensions to this issue, including such negative ones as the increasingly explicit consideration being given in recent years to the possibility of the use of force as a means of preserving access to needed raw materials. The particular concern here, however, is the magnitude of the consumption of energy and minerals for military purposes.

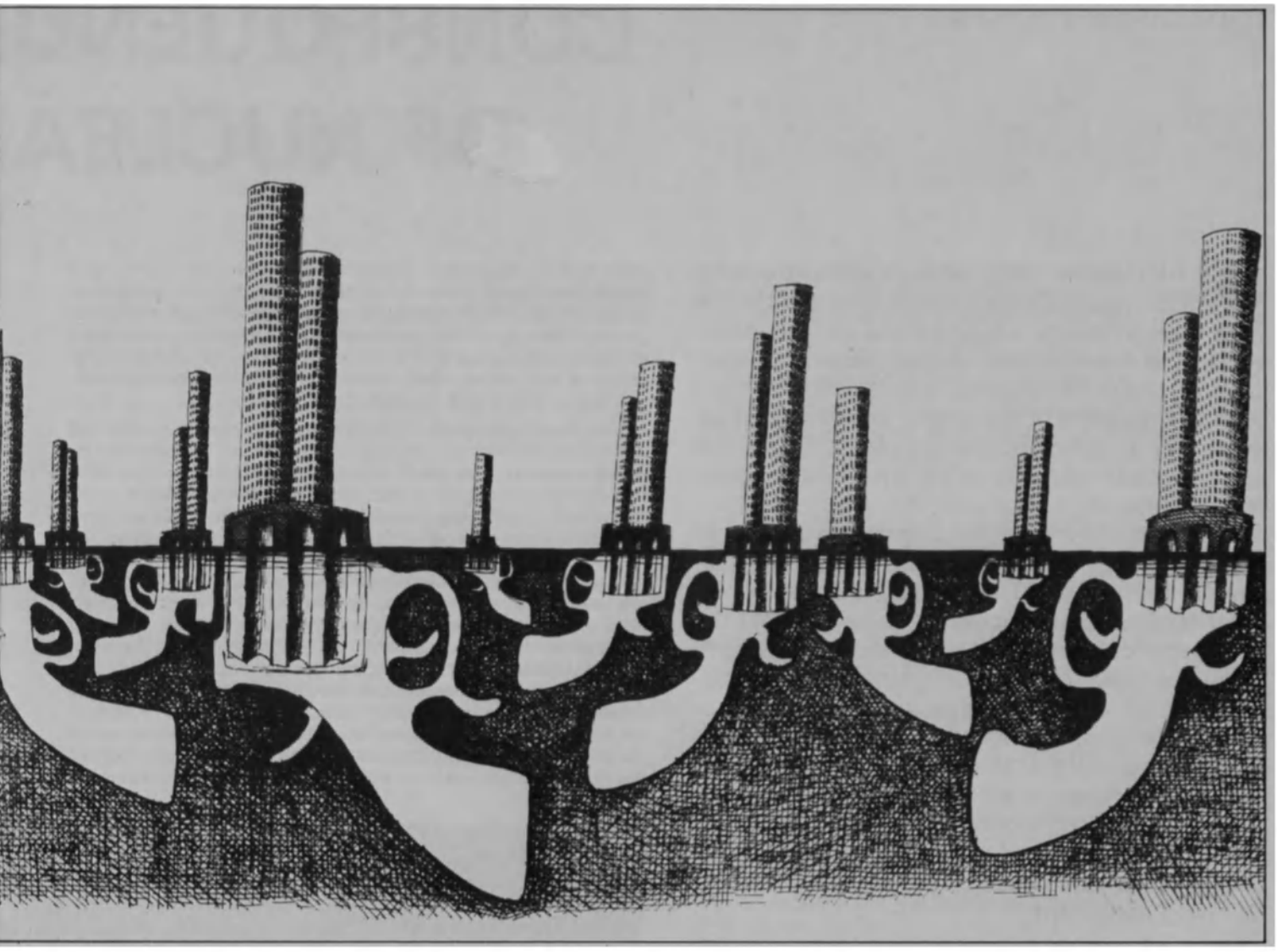
The scale of global military activities suggests strongly that consumption for these purposes is not trivial. At the same time, the stress placed on the achievement of costly qualitative improvements in weaponry since the Second World War would mean that this consumption has not increased commensurately with global military expenditure. Similarly, the spectacular rise in the unit cost of weapons due to their complexity and sophistication has contributed to a gradual decline in the number produced.

It can also be inferred from the emphasis on qualitative advances that the relative importance of iron and steel in military consumption has declined while that of aluminium, titanium and other relatively exotic minerals has increased. For example, approximately 20 to 25 per cent of the weight of current sophisticated combat aircraft is made up of titanium compared to 8 to 10 per cent for the models produced in the 1950s. This metal is also beginning to be used for the hulls of certain types of submarines. Similarly, aluminium has come into extensive use in the superstructure of modern naval vessels.

As a final example, the materials required to build and deploy the 200 land-based mobile, intercontinental ballistic missiles include an estimated 10,000 tons of aluminium, 2,500 tons of chromium, 150 tons of titanium, 24 tons of beryllium, 890,000 tons of steel and 2.4 million tons of cement.

The table opposite shows our estimates of the global consumption for military purposes of selected minerals. In order to convey some impression of the orders of magnitude involved it can be pointed out that, in the case of aluminium, copper, nickel and platinum, estimated global consumption for military purposes is greater than the demand for these minerals for all purposes in Africa, Asia (including China) and Latin America combined.

The final issue that warrants mention is the consumption of petroleum for military purposes. Petroleum is much more important for the military sector than for the economy as a whole, its share being more than three fourths of total military energy consumption. Including indirect consumption, that is, including petroleum consumed in the production of military goods and services, this has been estimated at 5 to 6 per cent of total global consumption. Once again the absolute magnitude involved is very significant: 5 per cent of global petroleum consumption is more than that accounted for by France and close to one half of the consumption in all the developing countries combined (excluding China). ■



Drawing by Tim · *L'Express*, Paris

Estimated military consumption of selected minerals as a percentage of total consumption

Mineral	Percentage
Aluminium	6.3
Chromium	3.9
Copper	11.1
Fluorspar	6.0
Iron ore	5.1
Lead	8.1
Manganese	2.1
Mercury	4.5
Nickel	6.3
Platinum group	5.7
Silver	6.0
Tin	5.1
Tungsten	3.6
Zinc	6.0

Sources : E.E. Hughes *et al., Strategic Resources and National Security: An Initial Assessment* (Menlo Park, Stanford Research Institute, 1975). *The Global 2000 Report to the President: Entering the Twenty-First Century (Washington, D.C., U.S. Government Printing Office, 1980),* vol. II, pp. 206-207.

CONSEQUENC
OF NUCLEA

ON 7-8 October 1981, under the chairmanship of Professor Carlos Chagas, President of the Pontifical Academy of Sciences, at the headquarters of the Academy (Casina Pius IV, Vatican City), a group of fourteen specialized scientists from various parts of the world* assembled to examine the problem of the consequences of the use of nuclear weapons on the survival and health of humanity.

Although most of these consequences would appear obvious, it seems that they are not adequately appreciated. The conditions of life following a nuclear attack would be so severe that the only hope for humanity is prevention of any form of nuclear war. Universal dissemination and acceptance of this knowledge would make it apparent that nuclear weapons must not be used at all in warfare and that their number should be progressively reduced in a balanced way.

The above-mentioned group discussed and unanimously approved a number of fundamental points, which have been further developed in the following statement.

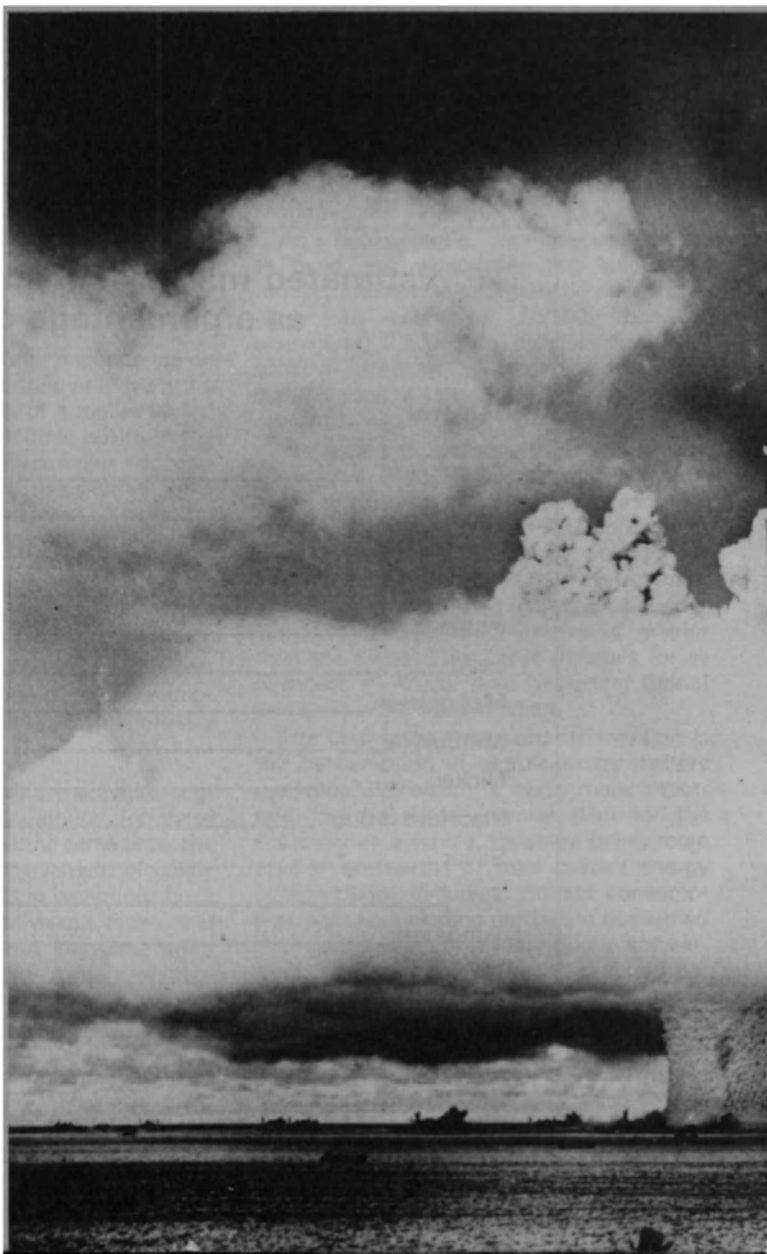
Recent talk about winning or even surviving a nuclear war must reflect a failure to appreciate a medical reality: any nuclear war would inevitably cause death, disease and suffering of pandemic proportions and without the possibility of effective medical intervention. That reality leads to the same conclusion physicians have reached for life-threatening epidemics throughout history: prevention is essential for control.

In contrast to widespread belief, much is known about the catastrophe that would follow the use of nuclear weapons. Much is known too about the limitations of medical assistance. If this knowledge is presented to people and their leaders everywhere, it might help interrupt the nuclear arms race. This in turn would help prevent what could be the last epidemic our civilization will know.

The devastation wrought by an atomic weapon on Hiroshima and Nagasaki provides direct evidence of the consequences of nuclear warfare, but there are many theoretical appraisals on which we may also draw. Two years ago, an assessment undertaken by a responsible official agency described the effect of nuclear attacks on cities of about two million inhabitants. If a one-million-ton nuclear weapon (the Hiroshima bomb approximated 15,000 tons of explosive power) exploded in the central area of such cities, it would result, as calculated, in 180 km² of property destruction, 250,000 fatalities and 500,000 severely injured. These would include blast injuries, such as fractures and severe lacerations of soft tissues, thermal injuries such as surface burns, retinal burns and respiratory tract damage and radiation injuries, both acute radiation syndrome and delayed effects.

Even under optimal conditions, care of such casualties would present a medical task of unimaginable magnitude. The study projected that if 18,000 hospital beds were available in and around one of these cities, no more than 5,000 would remain relatively undamaged. These would accommodate only 1 per cent of the human beings injured, but it must be stressed that in any case no one could deliver the medical service required by even a few of the severely burned, the crushed and the radiated victims.

The hopelessness of the medical task is readily apparent if we consider what is required for the care of the severely injured patients. We shall cite one case history, that of a severely burned twenty-year-old man who was taken to the burn unit of a Boston Hospital after an automobile accident in which the gasoline tank had exploded. During his hospitalization he received 140 litres of fresh-frozen plasma, 147 litres of fresh-frozen red blood cells, 180 millilitres of platelets and 180 millilitres of albumin. He underwent six operative procedures during which wounds involving 85 per cent of his body surface were closed with various types of grafts, including artificial skin. Throughout his hospitalization, he required mechanical ventilation. Despite these and many other heroic measures, which stretched the resources of one of the world's most comprehensive institutions, he died on his thirty-third hospital day. His injuries were likened by the doctor who supervised his care to those described for



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Carlos Chagas, Rio de Janeiro; E. Amaldi, Rome; N. Bochkov, Moscow; L. Caldas, Rio de Janeiro; H. Hiatt, Boston; R. Latarjet, Paris; A. Leaf, Boston; J. Lejeune, Paris; L. Leprince-Ringuet, Paris; G.B. Marini-Bettolo, Rome; C. Pavan, São Paulo; A. Rich, Cambridge, Mass.; A. Serra, Rome; V. Weisskopf, Cambridge, Mass.

ES OF THE USE
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many of the victims of Hiroshima. Had twenty score of such patients been presented at the same time to all of Boston's hospitals the medical capabilities of the city would have been overwhelmed. Now, consider the situation if, along with the injuries to many thousands of people, most of the medical emergency facilities had been destroyed.

A Japanese physician, Professor M. Ichimaru, published an eyewitness account of the effects of the Nagasaki bomb. He reported: "I tried to go to my medical school in Urakami which was 500 meters from the hypocentre. I met many people coming back from Urakami. Their clothes were in rags and shreds of skin hung from their bodies. They looked like ghosts with vacant stares. The next day I was able to enter Urakami on foot and all that I knew had disappeared. Only the concrete and iron skeletons of the buildings remained. There were dead bodies everywhere. On each street corner, we had tubs of water used for putting out fires after air raids. In one of these small tubs, scarcely large enough for one person, was the body of a desperate man who sought cool water. There was foam coming from his mouth, but he was not alive. I cannot get rid of the sounds of the crying women in the destroyed fields. As I got nearer to the school there were black, charred bodies with the white edges of bones showing in the arms and legs. When I arrived some were still alive. They were unable to move their bodies. The strongest were so weak that they were slumped over on the ground. I talked with them and they thought that they would be O.K. but all of them would eventually die within two weeks. I cannot forget the way their eyes looked at me and their voices spoke to me forever..."

It should be noted that the bomb dropped on Nagasaki had a power of about 20,000 tons of TNT, not much larger than the so-called "tactical bombs" designed for battlefield use.

But even these grim pictures are inadequate to describe the human disaster that would result from an attack on a country by today's stockpiles of nuclear weapons, which contain thousands of bombs with the force of one million tons of TNT or greater.

The suffering of the surviving population would be without parallel. There would be complete interruption of communications, of food supplies and of water. Help would be given only at the risk of mortal danger from radiation for those venturing outside buildings in the first days. The social disruption following such an attack would be unimaginable.

The exposure to large doses of radiation would lower immunity to bacteria and viruses and could, therefore, open the way for widespread infection. Radiation would cause irreversible brain damage and mental deficiency in many of the exposed in utero. It would greatly increase the incidence of many forms of cancer in survivors. Genetic damage would be passed on to future generations, should there be any.

In addition, large areas of soil and forests as well as livestock, would be contaminated reducing food resources. Many other harmful biological and even geophysical effects would be likely, but we do not have enough knowledge to predict with confidence what they would be.

Even a nuclear attack directed only at military facilities would be devastating to the country as a whole. This is because military facilities are widespread rather than concentrated at only a few points. Thus, many nuclear weapons would be exploded. Furthermore, the spread of radiation due to the natural winds and atmospheric mixing would kill vast numbers of people and contaminate large areas. The medical facilities of any nation would be inadequate to care for the survivors. An objective examination of the medical situation that would follow a nuclear war leads to but one conclusion: prevention is our only recourse.

The consequences of nuclear war are not, of course, only medical in nature. But those that are compel us to pay heed to the inescapable lesson of contemporary medicine: where treatment of a given disease is ineffective or where costs are insupportable, attention must be turned to prevention. Both conditions apply to the effects of nuclear war. Treatment would be virtually impossible and the costs would be staggering. Can any stronger argument be marshalled for a preventive strategy?

Prevention of any disease requires an effective prescription. We recognize that such a prescription must both prevent nuclear war and safeguard security. Our knowledge and credentials as scientists and physicians do not, of course, permit us to discuss security issues with expertise. However, if political and military leaders have based their strategic planning on mistaken assumptions concerning the medical aspects of nuclear war, we feel that we do have a responsibility. We must inform them and people everywhere of the full clinical picture that would follow a nuclear attack and of the impotence of the medical community to offer a meaningful response. If we remain silent, we risk betraying ourselves and our civilization. ■

4
LAND

An estimated 500,000 square kilometres used for military purposes

"Prevailing military trends suggest that, in the aggregate, military demand for land will continue to grow."

THE available data on the land area used for military purposes is far too sketchy to permit a reliable global estimate to be made. What is almost certain, and unsurprising, is that from the global perspective the military use of land is quite small, less than half of one per cent of the total and perhaps as low as one third of one per cent. Having said this, however, it does not follow that the military use of land is without consequence.

In absolute terms, the military sector still occupies much land: countries with a land area in the range of 0.3 to 0.5 per cent of the world total include France, Morocco, Paraguay, Sweden and Thailand. Moreover, there are vast areas of land in the world that are of no more interest to the military than to other land-users. In other words, despite its small relative demand, the military can and often does compete directly with civilian demands be they urban, industrial, agricultural, recreational or based on environmental concerns.

Military requirements for land have risen steadily over the course of this century owing to the increase in the size of standing armed forces and, more particularly, the rapid pace of technological advances in weaponry. As armed forces became progressively more mechanized and as the range and speed of weapons increased, so did the land area required for purposes of training and manœuvres.

For example, exercises involving a full armoured division are considered by the United States Army to require an area of at least 235 square kilometres with up to 664 square kilometres being desirable for maximum benefit. Air Forces require much larger areas still, owing to the high speed of modern combat aircraft and the considerable range capabilities of air-to-surface munitions.

Finally, of course, the areas used to test nuclear weapons cannot be too large. One could add here that, owing to considerations both of safety and security, military land requirements usually tend to be determined quite liberally.

Prevailing military trends suggest that, in the aggregate, military demand for land will continue to grow. Many countries in all parts of the world are increasing the size of their armed forces. Similarly, the number of countries operating battle tanks, modern combat aircraft and missiles of all varieties is growing continuously. So too is the number of countries setting out to manufacture and, in some cases, to design and develop modern weaponry.

All of these trends imply growing land requirements for training, manœuvres and weapon-testing. Furthermore, as the accuracy of offensive weapons improves, there is greater incentive to give deployed weapons greater mobility, and to set aside larger areas of land for them to manœuvre in. The deployment mode currently under consideration in the United States for the MX system involves an area of nearly 15,600 square kilometres. The Soviet Union already

Photomontage © Peter Kennard

has land-mobile intermediate-range nuclear missile systems that presumably have comparable designated areas that are off-limits to civilians.

On the whole, the economic significance of the diversion of land to military use is considerably higher than the fraction of the total land used for this purpose might suggest. The amount of land in the world is nearly constant, but demand is growing relentlessly on every front: croplands, grazing lands, forests, urbanization and ground transportation networks.

The amount of arable land in the world has in fact been increased by some 15 per cent over the past thirty years. It is reasonable to assume, however, that this has been accomplished to some extent at the expense of grazing land and forests and, to the degree that this is the case, it is not a viable alternative in the long run. Moreover, it is also the case that large areas of productive land are lost each year for such reasons as over-exploitation, desertification and salination. The restoration of these areas is a costly and time-consuming process.

In other words, the context in which the military use of land must be considered is one that recognizes that such use is totally unproductive and that it is frequently competitive with intensifying demands from the civilian sector. Perhaps the most disturbing aspect of the military use of land for future civilian use is that the land is seriously degraded, often for an extended period. In some cases, such as nuclear-weapon-test areas—particularly, of course, the areas where atmospheric tests have been conducted—the land will be totally unfit for civilian use for an indefinite period.

Moreover, the effects of atmospheric nuclear tests cannot be contained within the designated test area. Even with underground testing, accidents and miscalculations have occurred and have resulted in adverse effects beyond the test area. Training areas that see the large-scale use of tracked armoured vehicles become quite vulnerable to erosion through the destruction of vegetation and loosening of the topsoil. Artillery and bombing ranges are transformed into a mosaic of craters that are difficult to fill and remain unproductive for years, even if this happens owing to the absence of the fertile layer of topsoil. If the craters remain, they impede the use of agricultural machinery. Unexplored munitions constitute another long-term hazard. Actual warfare, of course, results in all these effects on a hugely magnified scale. ■

5
RESEARCH AND DEVELOPMENT

Twenty per cent of the world's scientists and engineers were engaged in military work during the 1970s

ONE of the most conspicuous features of the military scene since the Second World War has been the extraordinarily rapid rate of change in weapons technology.

For the past thirty years, new and improved weapons have emerged at an unmanageably rapid rate, compounding suspicions and uncertainties and creating in States, particularly the major Powers, a degree of preoccupation with military matters that is probably unprecedented. All too often technology has raced ahead of strategy and tactics. Similarly, the technological arms race has complicated the process of political assessment and efforts to control the race through negotiation.

In virtually all categories of major weapons a completely new model comes along every five to eight years, with an intervening period characterized by the continuous refinement and modification of the earlier model (or models). Moreover, the range of types of weapons in which this process occurs has expanded continuously as technological developments have made conceptually new weapons possible or permitted greater functional specialization. SIPRI estimates of the research and development input per unit of output in the military and civilian sectors in the United States of America, the United Kingdom and the Federal Republic of Germnay, suggest that, at present, the average military product is some twenty times as research-intensive as the average civil product.

These indications of the relative intensity of the military research and development effort are fully borne out by what is known or can reasonably be surmised about the global magnitude of this effort. Global expenditures on military research and development in 1980 were of the approximate order of $35,000 million or approximately one quarter of the estimated $150,000 million expended for all research and development.

Twenty years earlier, in 1960, global military research and development amounted to about $13,000 million but accounted for a significantly larger fraction of all research and development. This can be deduced from the fact that six countries—the United States, the Soviet Union, the Federal Republic of Germany, Japan, France and the United Kingdom—accounted for about 85 per cent of the world's research and development, and in five of these (all except the Soviet Union), it is known that the military share in total research and development was significantly higher in 1960 than it is today.

Military research and development expenditure is even more highly concentrated than total research and development; just two countries, the United States and the Soviet Union, account for a similar share of military research and development. Adding France and Britain would push this fraction above 90 per cent.

Information on the number of scientists and engineers in military research and development is even more sketchy than the financial data. The most recent survey of global research and development suggest that 2,279,000 scientists and engineers were thus employed in 1973. The best known estimate of the number engaged in military research and development is the SIPRI figure of 400,000 for the early 1970s. More recently it has been suggested that over 500,000 scientists and engineers are engaged in military research and development. In other words, approximately 20 per cent of the world's qualified scientists and engineers were engaged in military work during the 1970s. As with expenditure, this share would have been significantly higher during the 1960s and perhaps even higher still during the latter part of the 1950s.

It should be recalled that a 1972 United Nations study, *Disarmament and Development*, gives the share of military research and development as 40 per cent of expenditures ($25 thousand million out of $60 thousand million). As this figure, or even higher figures, are widely quoted in the public debate, it might be useful to stress that the most recent estimates point to a share of resources used for military research and development of the order of 20 to 25 per cent as regards both manpower and expenditure.

Even so the absolute magnitude of expenditures for military research and development is extremely large and it remains by far the largest single objective of scientific inquiry and technological development.

If a more accurate accounting were possible, the figures presented above would almost certainly appear conservative. For example, much of the expenditure on space activities in the United States and the Soviet Union has direct or strongly indirect military utility and is undoubtedly undertaken primarily for this purpose. More than $10,000 million is spent on "non-military" space activities each year by these countries and others.

It is important to view military research and development with some perspective. The stock of knowledge at any given point in time is the direct result of the research and development effort over the preceding decades and, indirectly, of this effort over the preceding centuries. It is likely that the present stock of useful knowledge is much less than it might have been had we not pursued the arms race so enthusiastically.

It is true that several technological developments of major significance for civilian life were brought to fruition at an early date because of their perceived military utility. This does not mean, of course, that progress in these spheres would have been slower in the absence of military research and development. It is possible that without the latter the requisite advances in the economic and social spheres could have been achieved more efficiently. An assessment of how far the development of the stock of really useful knowledge has been promoted or held back by the carrying-out of military research and development would require a special study, the conclusions of which would rest more on hypotheses than empirical evidence.

It has been suggested that military demands have been largely responsible for the rapid increase in the resources devoted to research and development generally so that even the magnitude of the civilian efforts might be jeopardized by a process of disarmament and the reduction of tensions. This view might have some validity if the economic and social state of the world was robust and no significant future problems could be identified, but it could hardly be said that there is now a shortage of possible civilian projects on which defence R and D scientists could be re-employed.

On a more positive note, it must be acknowledged that the military pioneered and perfected the systems approach on research and development. This has imparted a degree of predictability to the accomplishment of scientific and technological advances unknown before the Second World War.

For these various reasons, we can state with some confidence that the stock of useful knowledge and technology in the year 2000 will be immeasurably enlarged if we succeed in diverting to civilian ends a considerable fraction of the funds and manpower now programmed to work in the military field. ■

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"Global expenditure for education has only recently overtaken military expenditure."

6
MILITARY EXPENDITURES
In 1980, 110 dollars for every man, woman and child on earth

WORLD military expenditure in 1980, at current prices, amounted to $500,000 million or approximately $110 for every man, woman and child on earth. *Per capita* military expenditure in the developed countries taken as a group is an order of magnitude higher than that in the developing countries but, because the disparities in overall income *per capita* are even greater, the real burden of these expenditures is heavier in developing countries.

The global military effort represents about 6 per cent of global output, roughly the same fraction as accounted for by the 340 million people living in Latin America or the 1,300 million people living in Africa and South Asia.

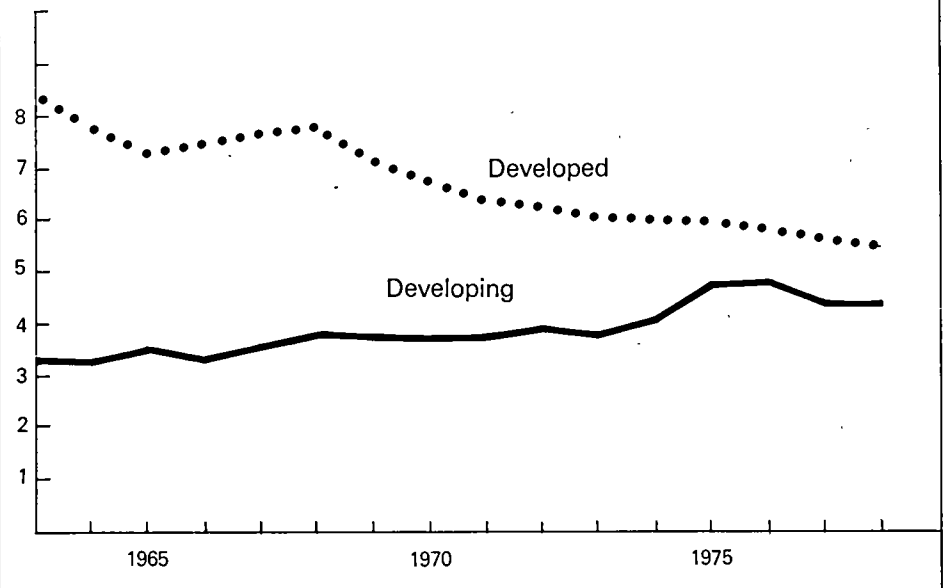
Global public expenditure for education has only recently overtaken military expenditure, although if the developing countries alone are considered the latter is still predominant. Global public expenditure on health remains considerably below military expenditure and, again, the asymmetry is particularly marked in the developing countries as a group. The global arms bill is roughly equivalent to the value of gross fixed capital formation in all developing countries combined. If one combines regular and paramilitary forces, there are still far more people wearing military uniforms world wide than there are teachers.

Military objectives remain by far the most important single purpose of the world's research and development effort, eclipsing, for example, energy, health, pollution control and agriculture *combined*. Indeed, it appears that global military research and development is at least six times as great as *all* research and development performed in the developing countries.

World military expenditure over the post-war period has moved up in spasms followed by a period of relative stability on a new and higher plateau. In the past, each upward surge was closely associated with a war or a major international crisis or the perception of a serious asymmetry in strategic nuclear capabilities. The present upward trend is not associated with a specific event. Rather, it appears to reflect a widespread perception that circumstances in general justify a gradual but sustained increase in military efforts. In this sense, the latest upswing may prove more difficult to reverse since there is no major war that can be brought to an end, no single crisis that can be defused and no particular gap in relative capabilities that can be bridged.

The distribution of global military expenditure remains very uneven although some notable changes have occurred over the ▶

Military expenditure as a percentage of GNP, 1963-1978



Developed countries include NATO, WTO, other European countries plus Australia, China, Israel, Japan, New Zealand and South Africa.

Source : United States Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfer,* Washington, D.C., various years.

Distribution of world military expenditures, 1955-1980

*(Percentage)**

Groupings	1955	1960	1965	1970	1975	1980
Nuclear weapon States (a)	81.4	78.9	76.0	75.8	67.1	64.6
Four leading arms exporters (b)	76.2	73.3	67.4	65.8	57.4	55.8
NATO and WTO of which:	86.9	85.4	80.5	77.4	70.5	68.8
United States and USSR (c)	(68.7)	(63.7)	(48.9)	(47.4)	(31.9)	(27.1)
Other developed (d)	9.8	10.1	13.6	15.4	16.0	15.1
Developing countries of which:	3.3	4.5	5.9	7.2	13.5	16.1
Middle East (e)	0.6	0.9	1.3	2.2	7.3	7.8
South Asia	0.6	0.6	1.1	0.9	0.9	1.1
Far East (f)	1.0	1.4	1.4	1.6	1.9	3.6
Africa (g)	0.1	0.3	0.8	1.2	1.8	1.7
Latin America	1.0	1.3	1.3	1.3	1.6	1.8

* *Source: World Armaments and Disarmament, SIPRI Yearbook 1981,* pp. 156-169 (for all footnotes except (c).

(a) United States, USSR, France, United Kingdom, China.

(b) United States, USSR, France, United Kingdom.

(c) As recognized by the international community dealing with these matters, official military budget figures for one of these countries are not directly comparable to those of most other countries, owing to differences in coverage and difficulties with currency conversion rates. Stockholm International Peace Research Institute (SIPRI) estimates for the share of the United States and the Union of Soviet Socialist Republics in world military expenditures are as follows:

1955	1960	1965	1970	1975	1980
66.0	62.6	58.2	58.7	50.1	48.0

(d) Europe, excluding NATO and WTO, plus Australia, China, Israel, Japan, New Zealand and South Africa.

(e) Excluding Israel.

(f) Excluding China and Japan.

(g) Excluding South Africa.

▶ past two decades (see table this page). Generally speaking, there has been a significant decline in the NATO/WTO share although the Member States of these two military alliances still account for nearly 70 per cent of the total. Significantly, however, the NATO/WTO share appears to be stabilizing at this figure.

The offsetting increases have taken place in virtually all regions of the world but, again, the picture is a very uneven one. China and, to a lesser extent, Japan, Israel and South Africa account for nearly all of the increases in the share of the other developed countries. Among the developing regions, the spectacular pace of militarization in the Middle East is clearly reflected. Even excluding Israel, this region accounts for nearly one half of total military spending by the developing countries. The share for Africa has also increased particularly rapidly although here, more than in any other developing region, the trend has been influenced by the emergence of new nations.

Other factors have been a succession of

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wars over the past decade and an intensifying confrontation between the Black African States and South Africa. While these various qualifications are important, the central fact remains that the distribution of world military expenditure has been changing in a quite systematic manner over the past twenty-five years. In all the major regions of the world, the average rate of growth of military expenditure has at least equalled, and, in most cases exceeded, that of NATO and WTO combined.

Bearing in mind that governments in all countries (particularly, perhaps, developing countries), bear a major responsibility for providing the basic prerequisites for economic activity, these percentages are significantly large. By 1977, the situation had improved markedly compared to 1968, but it is worth pointing out that the effects of relatively greater diversion of government resources to the military in the past are still being felt today, in terms of education, health, housing, transportation networks and so on. ■

Military expenditure as a percentage of central government expenditure, by regions, 1969 and 1978

	1969	1978
World	33.5	22.4
Europe	32.8	24.4
North America	41.3	22.6
Oceania	15.4	8.4
Middle East	28.5	24.3
Far East	31.5	22.5
South Asia	20.4	15.0
Africa	15.0	10.2
Latin America	13.5	10.9

Source : United States Arms Control and Disarmament Agency, *World Military Expenditure and Arms Transfers 1969-78, Washington D.C., December 1980.*

SWORDS INTO PLOWSHARES

On the key issue of employment virtually all possible alternatives to military expenditure will result in as many, if not more, jobs being created

THE terms *conversion* and *redeployment* describe the process of change whereby real human and material resources shift from the production of one set of goods and services to the production of another.

The specific concern here is the shift of resources from the production of commodities and services for military purposes to goods and services that can contribute to economic and social development. More particularly, we are concerned with conversion and redeployment of the resources involved in the production of commodities used or consumed by the military and which have little or no civilian utility.

A significant part of military demand is directed at goods and services that are essentially identical to those consumed in the civilian sector. In this case, the problem is the relatively minor one of ensuring that civilian demand fills the gap left by cutbacks in military spending.

This is not the case with nuclear and chemical weapons, combat aircraft, missiles, warships, tanks and so on. The resources involved in producing these items are likely, in varying degrees, to be unsuited for the production of civilian goods, so that explicit consideration must be given to the ways in which their capabilities can be altered to permit the smoothest possible transition to the production of socially useful goods and services.

Conversion and redeployment are not associated exclusively with disarmament. Any form of economic and social development represents a continuous process of conversion. Particularly in modern industrial economies, the factors of production must respond continuously to the development of new products and the phasing-out of old ones and to the introduction of new production techniques. Indeed, the pace of technological change and the extraordinary mobility of capital in recent decades have led most countries to undertake measures to facilitate necessary changes in the structure of industry and to adopt legislation to provide some protection for workers affected by such changes.

The point to be stressed is that modern industrial economies including, in particular, the economies with the largest military establishments, have a considerable inbuilt capacity to convert resources from one activity to another. Furthermore, any process of conversion and redeployment associated with disarmament measures, if developed in the context of even more far-reaching structural adjustments and modifications of national economies and of the international economic system, could be productively integrated into these wider changes.

Setting the problems of conversion in a wider perspective, it is important to bear in mind that the process of disarmament is almost certain to be quite gradual. In other words it is not at all realistic to portray the conversion problem as involving, in a single step, the need to replace $500 thousand million of demand or absorb tens of millions of persons into the civilian work-force.

In practical terms, the scale of the conversion problem stemming from disarmament measures will be orders of magnitude smaller than this at any given point in the process. Indeed, it is far more likely that the rate of disarmament agreed upon will lag behind conversion capabilities or, to state the matter less pessimistically, there should be no difficulty in gearing the rate of disarmament to the rate at which the resources involved can move smoothly to alternative activities.

Most general investigations of the conversion issue take as their starting-point the extraordinary success of demobilization following the Second World War.

In the United States between 1945 and 1948, some ten million persons were released from the armed forces and the defence budget declined by nearly $40 thousand million. Similarly, defence-related employment in industry fell from over twelve million persons in 1945 to less than one million in 1946.

In the United Kingdom, seven million persons were demobilized within sixteen months to the end of the war. In neither country, however, did unemployment in the immediate post-war years exceed 4 per cent. The experience in the Soviet Union was similarly positive.

It is true, of course, that the particular circumstances prevailing at the end of the war contributed enormously to the success of the conversion effort. In the Soviet Union and, to a lesser extent, the United Kingdom, the rebuilding of war-damaged towns and industries provided a major outlet for the production capacities released by demobilization. In the United States and also in the United Kingdom, a surge in consumer demand—produced by years of relative deprivation and accumulated savings—played a major role in sustaining aggregate demand.

From the industrial standpoint, another important consideration is that for most plants and factories the problem was that of reconverting to the civilian products produced before the war. While these conditions undoubtedly facilitated post-war conversion, the fact remains that an enormous economic adjustment was accomplished far more smoothly than most experts had considered possible. Of particular importance in this regard is that the anticipation of major problems led to detailed planning of the measures needed to accomplish the transition from war to peace. This process began well before the end of the war and is considered by some to have made a major contribution to the success of the conversion process.

In the Soviet Union, the first post-war economic plan appeared within six months of the termination of hostilities. And in the United States, the Government was ready with an array of remedies including graduated demobilization, specific incentives for the mass production of consumer durables, low interest rates to encourage spending and generous adult education programmes. ▶

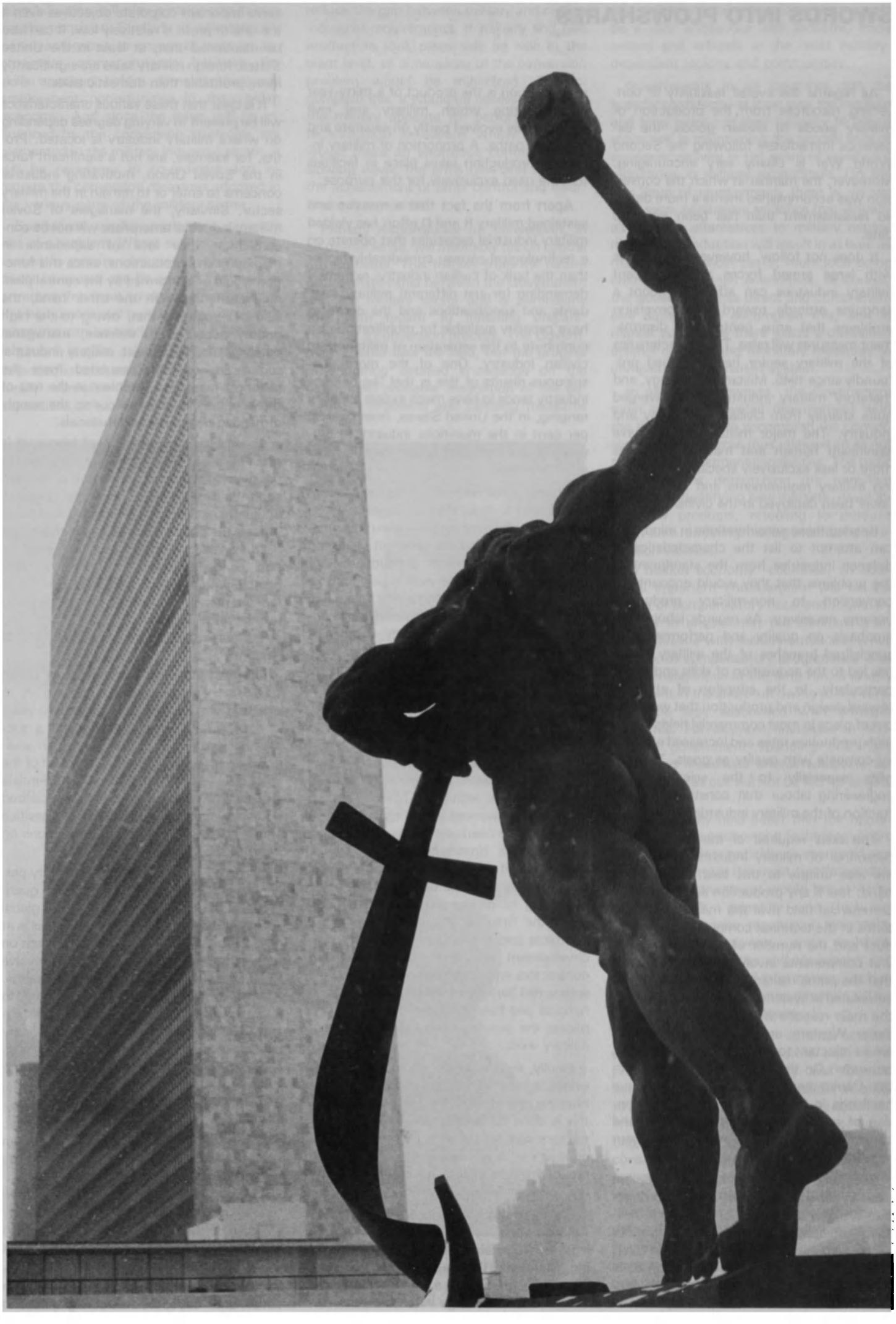

Photo United Nations, New York

▶ As regards the overall feasibility of converting resources from the production of military goods to civilian goods, the experience immediately following the Second World War is clearly very encouraging. Moreover, the manner in which the conversion was accomplished merits a more detailed reassessment than has been made to date.

It does not follow, however, that States with large armed forces and significant military industries can afford to adopt a sanguine attitude toward the conversion problems that arms control and disarmament measures will raise. The characteristics of the military sector have changed profoundly since 1945. Military technology, and therefore military industry, have diverged quite sharply from civilian technology and industry. The major military powers have significant human and material resources more or less exclusively specialized in fulfilling military requirements and which have never been deployed in the civilian field.

Bearing these considerations in mind, one can attempt to list the characteristics of defence industries from the standpoint of the problems that they would encounter if conversion to non-military production became necessary. As regards labour, the emphasis on quality and performance in specialized branches of the military sector has led to the acquisition of skills and, more particularly, to the adoption of attitudes toward design and production that would be out of place in most commercial fields where high production rates and increased efficiency compete with quality as goals. This applies especially to the scientific and engineering labour that constitute a large fraction of the military industrial work-force.

The skills required of the management personnel of military industrial enterprises are also unique to this field. On the one hand, few if any production activities in the commercial field rival the military sector in terms of the technical complexity of the product and the number of suppliers of parts and components involved. The experience that the prime military contractors have accumulated in systems management is one of the main reasons why Governments in the major Western arms-producing countries are so reluctant to see any of these concerns go under. On the other hand, dealing with the Government as a buyer is a unique challenge in marketing, requires the adoption of special accounting procedures and conforming in general with government regulations.

Secondly, much of the capital equipment used in some branches of defence production is highly specialized and lacks the flexibility for application to civilian output. In sharp contrast to the Second World War, when civilian industry undertook to produce war material and then reconverted to production for the commercial market, the present situation is the product of a thirty-year period during which military and civil technologies evolved partly on separate and divergent paths. A proportion of military industrial production takes place in facilities that are used exclusively for this purpose.

Apart from the fact that a massive and sustained military R and D effort has yielded military industrial capacities that operate on a technological plateau considerably higher than the bulk of civilian industry, extremely demanding (or just different) military standards and specifications and the desire to have capacity available for mobilization also contribute to the separation of military from civilian industry. One of the more conspicuous results of this is that the defence industry tends to have much excess capacity ranging, in the United States, from over 90 per cent in the munitions industry to between 30 per cent and 50 per cent in most other branches.

Several other features of the defence industry tend to make the companies or enterprises involved apprehensive about disarmament measures and the prospect of having to convert to civilian production. For example, most defence-work is paid for on a continuous basis providing a very favourable cash-flow situation, particularly for financially weak companies. Similarly, companies accustomed to performing low-risk military R and D will be understandably nervous at the prospect of committing their own resources to the development and production of commodities for the uncertain and competitive civilian market.

These concerns will be amplified by the fact that companies specializing in military work will have legitimate fears regarding their competitiveness in the civilian sphere owing to large overhead costs—because the work-force is dominated by managerial, scientific and engineering personnel—and because they lack skill or experience in the marketing of civil products. Furthermore, given the financial magnitude of military contracts and the long periods involved in development and production, the major contractors will, at any given point, have a substantial backlog of military work for both national and foreign military forces to complicate the process of conversion to non-military work.

Finally, there is the question of profit. The evidence here is inconclusive: depending on how the rate of profit is computed, whether this is done for large or small defence contractors and for prime contractors or subcontractors, it is possible to show that the rate of profit in military industry is both high and low compared to civilian industry.

On the other hand, once a military contract has been secured the rate of profit is at least fairly certain owing to cost-plus pricing. Moreover, the magnitude of the profit that can be earned on a single military contract is often very large indeed and this can serve important corporate objectives even if the rate of profit is relatively low. It can also be mentioned that, at least in the United States, foreign military sales are significantly more profitable than domestic sales.

It is clear that these various characteristics will be present to varying degrees depending on where military industry is located. Profits, for example, are not a significant force in the Soviet Union, motivating industrial concerns to enter or to remain in the military sector. Similarly, the managers of Soviet military industrial enterprises will not be concerned at their lack of experience in marketing civil productions, since this function would be performed by the central planning authorities. On the other hand, the evidence suggests that, owing to the high priority accorded to defence, managerial personnel in the Soviet military industrial sector are relatively insulated from the foremost managerial problem in the rest of the economy, namely, securing the supply of needed personnel and materials.

As regards the retraining of labour, it is often assumed that the workers engaged in the development and production of modern sophisticated weapon systems possess uniquely specialized qualifications and skills. In fact, the professional skills needed in this field are linked in most cases with production techniques that are identical or comparable with those for civil products. Some reorientation and retraining may be required for certain specialized occupations and skills, particularly in respect of R and D personnel.

Informed judgement in the Soviet Union suggests that retraining for a period of up to one year for scientists and up to two years for certain engineers is needed for a successful transition to civilian work. An additional problem is that a significant part of the stock of knowledge possessed by scientists and engineers in certain specialized branches of the military sector is classified and would be wasted unless restrictions on its use were lifted.

The conversion of uniformed military personnel is a separate problem, both quantitatively and qualitatively. Since the global figure for personnel in the armed forces is at least twenty-five million, even agreement on modest force-level reductions could involve the demobilization of millions of persons. Furthermore, since the civilian economy, to a reasonable approximation, already provides for the consumption needs of military personnel, their demobilization will constitute an addition to the labour market.

Reference has been made above to the wide variety and growing level of skills required of military personnel. In broad terms, this will clearly ease the transition to civilian work, but the available evidence suggests that significant problems can still be anticipated. In the late 1960s, it was estimated that 80 per cent of the military jobs held by enlisted men in the United States armed forces corresponded to only about 10 per cent of those held by male civilian workers.

This fact, of course, suggests that vocational and educational training prior to

demobilization will play a major role in easing the transition. Similarly, it will obviously be advantageous to ensure at least an approximate correspondence between the skills acquired before demobilization and employment opportunities in the civilian economy. And since the latter will be influenced by the conversion strategies implemented in the military industrial sector, it will be necessary to co-ordinate and integrate the conversion measures adopted in the various parts of the military sector.

Specialized capital equipment presents less of a problem. Where such equipment is owned by private concerns a variety of indirect measures can be adopted to make it attractive for them to divest themselves of this equipment and by the State quite direct measures can be used.

Since it is quite unrealistic, at least for an extended interim period, to expect States to totally demolish their military industrial capabilities, it would be highly desirable to reduce the gap between military and civilian industrial requirements. If military and civil production took place side by side at the plant level, all dimensions of the conversion problem would be minimized. To accomplish this, it would be necessary to curb the military appetite for performance and technological excellence which, in itself, would make an enormous contribution to slowing down the arms race and facilitate the achievement of arms control and disarmament measures.

Primary responsibility for conversion, in an overall sense, will inevitably fall on central governments. This follows from the nature of the relationship between the Government and the military sector and is particularly true with regard to initiating preparations for a conversion process. The Government should take the lead, but the process of acquiring detailed knowledge on the nature and probable magnitude of the adjustment problems and devising measures and arrangements to overcome them would be a joint endeavour with industry, trade unions and officials in the most military-dependent regions and communities.

Governments in all countries can be broadly confident—at least over the medium and long terms—in their capacity to play a major role in maintaining the general level of economic activity in the event of significant reductions in military expenditure. On the key issue of employment, there is, as we have seen, persuasive evidence that virtually all possible alternatives to military expenditure and production will result in at least as many and, in most cases, more jobs being created. In planned economies, of course, the government has direct and comprehensive authority to accomplish this, and in market economies there exists a diversified arsenal of fiscal and monetary measures to complement the market system.

In all cases, however, the Government must carefully dovetail disarmament with the time required to accomplish the conversion of the resources thus released so as not to overtax adjustment capabilities. The basic considerations determining the transition period are identifying new markets, developing new products, retooling to produce them and retraining management and production workers.

In market economy countries, an additional important consideration will be the timing of compensatory fiscal and monetary policies to ensure that the stimulating effects coincide with military cutbacks. While the mix of compensatory programmes is of little consequence in the long run, it is very important in the short run owing to the varying time lags associated with different measures. For example, increases in non-military government spending will have direct and immediate effects while the full effects of a tax cut will not be felt for several years.

It is a widely held belief that the opportunity to apply science and technology more directly and systematically to economic and social problems is the most significant dividend that disarmament would bring. A nation's military, scientific and technical resources comprise manpower (scientists, engineers, technicians and technical management), facilities and equipment, and scientific and technical information. Each of these components requires separate attention for conversion purposes.

The formulation of a national science policy that reflects economic and social priorities both domestically and internationally would be extremely useful in order to give direction and focus to the conversion effort. The specific requirements for adapting personnel in military R and D will vary considerably among and within the different categories of personnel involved. Determining the probable requirements for retraining, re-education and redeployment will require detailed knowledge of the composition of the military R and D community. Thought must be given to how and where retraining and re-education is to be done and who would pay for it. ▶

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"Modern industrial economies, including in particular the economies with the largest military establishments, have a considerable inbuilt capacity to convert resources from one activity to another."

▶ As regards facilities and equipment, it would be necessary to compile a detailed national inventory as a basis on which to assess its adaptability to civilian R and D. Similarly, the stock of military, scientific and technical information can be declassified and systematically canvassed for possible civilian applications. An important complementary measure would be to encourage civilian industry to be more receptive to R and D. This could boost productivity and also generate a demand for management personnel with knowledge and experience in the effective use of R and D resources, that is, the type of management personnel employed in disproportionately large numbers in the defence industry.

The ambition—and the need—to make science and technology more responsive to economic and social requirements will not be realized in a straightforward fashion. It is true that such sectors as civil aerospace, research into alternative sources of energy, further development of nuclear energy technologies so as to make them safer for civilian use, or the design of remotely-controlled underwater devices for the extraction of raw materials are similar to the highly specialized technologies in some areas of the armaments sector.

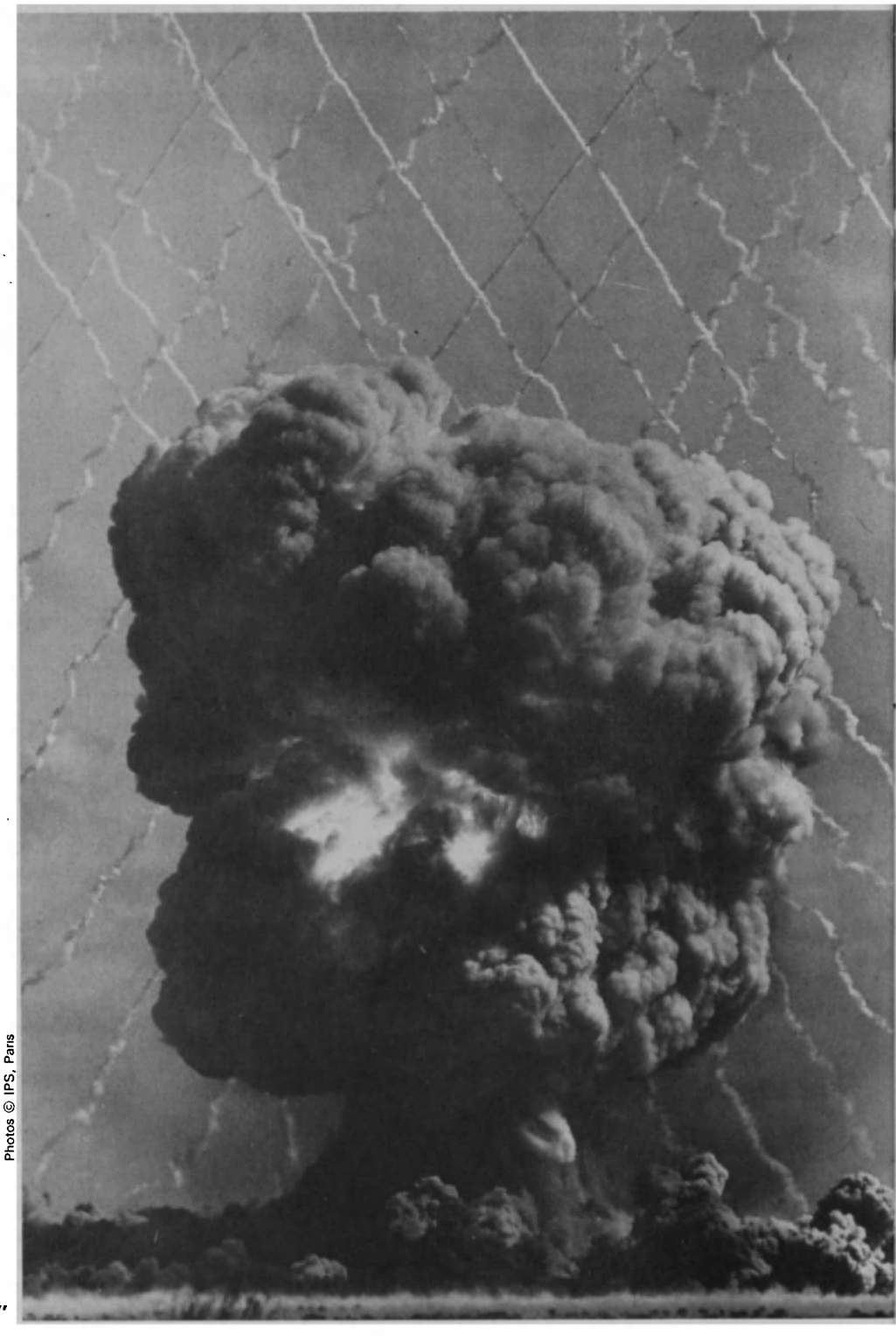
On the other hand, such issues as coping with pollution, improving the effectiveness and availability of education and increasing agricultural productivity in the developing countries are enormously different from and far more complex than the technical problems confronted in transporting a man to the moon or delivering a nuclear warhead accurately to a target 8,000 kilometres away.

It is perhaps no exaggeration to say that we are still quite ignorant as to how to apply R and D resources to such problems. Developing new methods, techniques and approaches for effectively applying scientific and technical resources to the resolution of economic and social problems will require a great deal of thought and experiment.

The general approach to conversion outlined with regard to military R and D can also be applied to military industry. The first order of business is to determine as accurately as possible which industries in which locations depend to a significant degree on military demand, the characteristics of the work-force involved and the type of plant and equipment used.

Where plant, equipment and manpower—and by implication, the product—are not unduly specialized for military purposes, the Government can determine whether general compensatory monetary and fiscal policy, together with market forces, will suffice to maintain demand and employment or whether more specific measures would be desirable. Input-output models can be employed to anticipate the extent to which the pattern of demand associated with compensatory policies might differ from that associated with military outlays. Where the mismatch is significant, more industry-specific measures could be prepared for possible implementation.

At the other extreme—represented by the munition plans and the prime military contractors in aerospace, electronics and shipbuilding—the problems are rather formidable. The Government, in conjunction with management and unions in the industry, must determine what alternative uses for these resources are feasible and desirable, with the feasible alternatives clearly more important in the short run. Once these strategic judgements have been



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"It is a widely held belief that the opportunity to apply science and technology more directly and systematically to economic and social problems is the most significant dividend that disarmament would bring."

made, the requirements for retraining, re-education and redeployment can be gauged and programmes developed to satisfy them. Similarly, the data base and a broad strategy for the alternative use of military industrial resources are essential elements for determining the nature, extent and duration of specific measures—tax concessions, investment incentives and the like—needed to accomplish the transition.

At least in market economies, the State would not have to concern itself with specifying alternative products in any detail or determining how they will be manufactured. Nor should it attempt to do so. Its role should be to guide and facilitate conversion and to alleviate the hardships imposed on the manpower resources displaced in the process.

Nevertheless, to perform this role effectively the State must be well informed of the difficulties associated with developing and producing a new product and the time required to accomplish it. Similarly, it must be prepared to eliminate any unreasonable barriers to entry to the civilian markets that the former suppliers of military equipment hope to penetrate. It should be stressed again, however, that this central dimension of the conversion issue—the resources directly employed in meeting the military demand for specialized goods and services—is not overwhelmingly large even in the most heavily armed States. Moreover, a process of disarmament will be gradual rather than abrupt and this will further diminish the magnitude of the problem at any particular time.

One question that will have to be considered with particular care is whether the prime military contractors can convert to civilian production and still retain broadly the same structure. It was pointed out above that these concerns have developed unique capabilities in scientific and systems management, that their work-force is markedly top heavy with scientists, engineers and technical management personnel and that their marketing skills are oriented exclusively toward government procurement.

Some analysts feel that conversion to civilian production will probably require that these large-scale units be broken up. Others, however, while granting the need to change habits and attitudes acquired in the military environment, argue that many important requirements in the civilian arena closely resemble large military projects in terms of scientific and technical input and requirements for strong capabilities in systems management. Examples here would include new sources of energy, exploiting the resources of the ocean, environmental protection and new systems for major cities in such areas as transportation and sanitation.

A particularly interesting aspect of conversion is that related to the resources now devoted to the development and production of chemical warfare agents. Efforts are now being made to permit negotiations to begin on a convention that would prohibit the development, production, deployment and stockpiling of chemical weapons and the secure destruction of such stockpiles.

A recent study by the Stockholm International Peace Research Institute concluded that conversion was technically feasible and would involve little or no disturbance for the work-force involved. On the one hand, it is considered technically feasible to break down stockpiled chemical warfare agents into their base materials and intermediate products and apply these to products useable for civilian purposes. Moreover, this process requires the same specially skilled scientific and technical personnel as are needed for the production of chemical warfare agents. On the other hand, it is quite feasible to produce commercial products such as pesticides, plasticizers and fire retardants in plants producing chemical warfare agents.

Ironically, the very ease of conversion is a serious drawback in this case because it would be relatively easy to rededicate the facility to agent production. Unless there were to be a breakthrough on the question of on-site inspection, verification of compliance with a chemical warfare convention would probably require that the facilities be shut down and broken up.

Given the almost universal judgement that, with appropriate preparation and planning, the transitional problems associated with conversion can be readily accommodated and bearing in mind that disarmament will almost certainly be a selective and gradual process, it should be apparent that the industrialized countries, including, in particular, the major military powers, do not lack important civilian uses for the resources now dedicated to the military. ▶

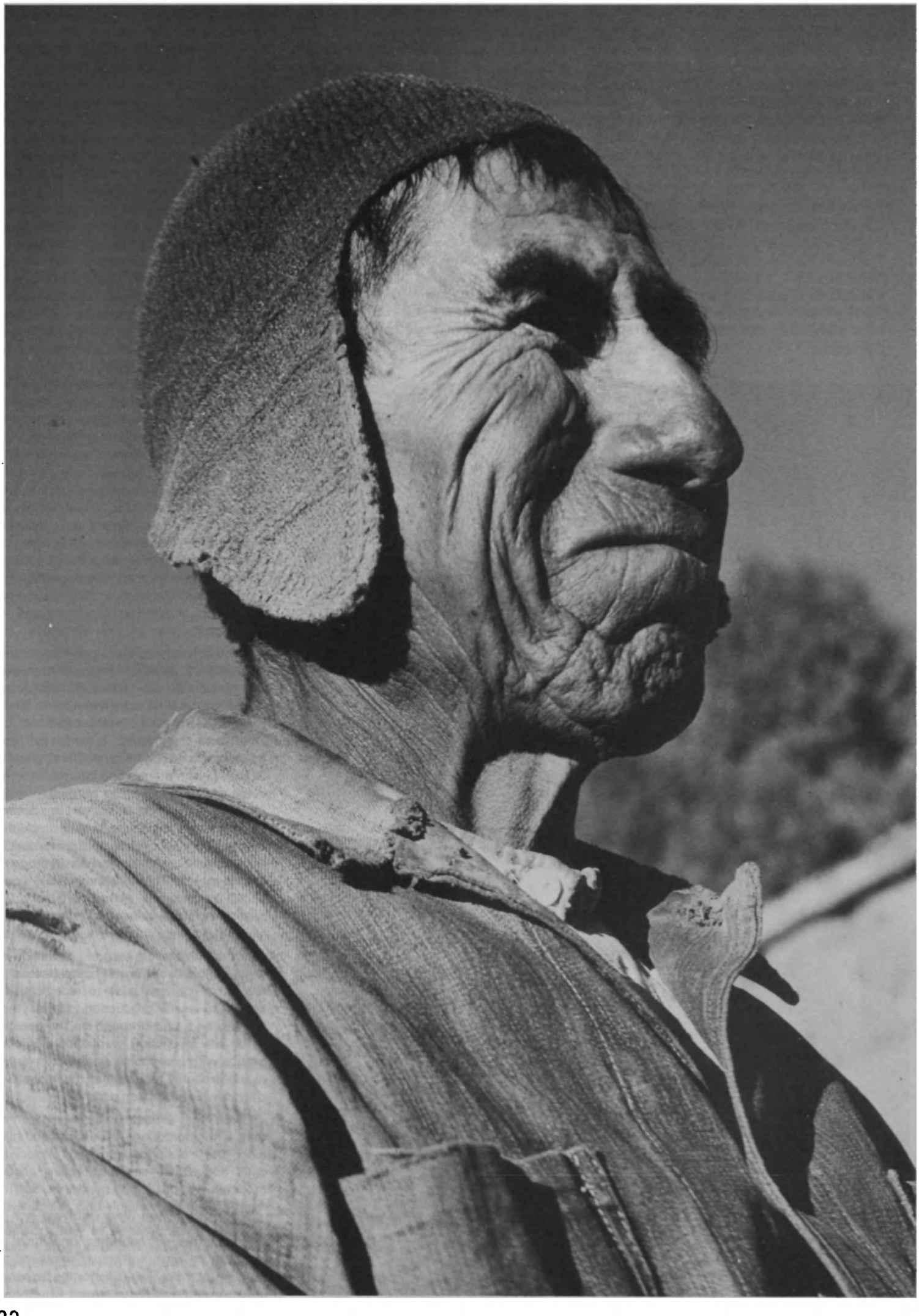

Photo ILO, Geneva

▶ It will be recalled that the developing countries still account for only about 16 per cent of global military expenditure and that this sum is heavily concentrated in a relatively small number of countries, particularly those in the Middle East region. With a few important exceptions, R and D for military purposes is negligible. The production and assembly of major weapons is considerably more widespread but, again, the scale of the effort is significant in only a few countries. By and large, the labour employed in the military sector will not be exclusively specialized in military work, and technology in military industry will not be so far removed from civilian industrial technology. It is true that industry in the developing countries is generally narrowly based and less dynamic than in developed countries so that the inherent capacity for adjustment and conversion is lower. On the whole, however, the problems associated with conversion would seem to be relatively small in all but a few developing countries and the benefits from disarmament easier to realize.

The military expenditures of the developing countries, which stood at some $73,000 million in 1980, are by no means inconsequential. Moreover, the alternative uses to which these resources might be applied are particularly compelling so that, as in the industrialized countries, governments will have to consider very carefully how the opportunities opened up by disarmament measures can be exploited to alleviate the burden of the most urgent economic and social problems and to help set the economy on a sounder and more independent footing.

In many developing countries, substantial disarmament would significantly ease prevailing financial constraints on the implementation of development plans. The reduction in the import of arms and spare parts and of capital goods and intermediate products for local military production would release foreign exchange to alleviate bottlenecks in the programmes for industrialization and the expansion of agricultural production. The armed forces, the military bureaucracy and personnel in defence industries would provide a pool from which to reduce shortages of various types of skilled labour and of managerial personnel. Moreover, the diversion to the military of able-bodied, educated and skilled manpower from schools, universities and technical institutions could be minimized.

Reducing the incidence of hunger and malnutrition will clearly be a priority claim on the resources released by disarmament measures both in the short term and the longer term. Education and health are two more areas which require vast resources even to make basic services and amenities available to all.

Under present conditions, many developing countries are projected to become more dependent on imported food over the next two decades. This is a serious hazard, both because the global balance between supply and demand could easily become delicate and because the real cost of food will almost certainly increase substantially so that major food import requirements will constitute an even heavier drain on foreign exchange reserves and, indirectly, on the capacity to sustain growth.

There are a variety of research and development challenges in this field: the development of high-yielding varieties of staple food for the diverse soil and climatic conditions found in developing countries, pest control, methods of food storage and processing suited to local conditions; water management and irrigation technologies; and tools and equipment that use local raw materials, can be produced domestically with low acquisition, operating and maintenance costs.

Recent advances in molecular biology hold particular promise for food-deficit developing countries. It is now considered possible to produce protein from bacteria and algae far more quickly and at considerably less cost than from animal and agricultural sources. It remains to translate this knowledge into facilities and processes suitable for application in developing countries. A recent investigation concluded that "... advances in enzyme engineering, microbial genetics and fermentation technology... point at new approaches to the development of small-scale processes that could form a logical take-off point for industrialization."

Two other areas in which the needs of the developing countries are very great and which offer considerable potential for the conversion of military R and D resources are health and education. For a variety of reasons, including, until recently, preparing for the possible use of biological weapons in warfare, the military in the industrialized countries have paid a great deal of attention to infectious diseases, food hygiene and the management of water and waste under field conditions. The knowledge acquired and the preventive capabilities developed have potentially great applications in improving health conditions in developing countries.

It has also been suggested that military capabilities in the biological sciences could be readily applied to the fight against infectious diseases, particularly those in childhood, with military skills in organization and logistic planning providing essential backup to ensure the systematic and effective implementation of remedies. As mentioned previously, modern communication technologies and new media techniques offer great potential for making educational facilities more generally available in developing countries. The practical application of these skills appears to be a fruitful alternative use for the engineering and systems management capabilities of the military sector in the industrialized countries.

In any list of alternative uses for military capabilities mention should also be made of the vast quantities of resources needed to alleviate suffering and to help in reconstruction as a result of the more or less predictable cycle of natural disasters. The worldwide refugee problem also calls for vast quantities of resources if the refugees' basic requirements for survival are to be met. These are two areas in which the international community has shown intself in recent times to be willing to assume a collective responsibility.

A structural transformation such as the conversion to civilian activities of the resources now employed for military purposes will be much easier to accomplish in a dynamic economic environment.

The existence of broad agreement on where the solution lies is a far cry from the elaboration and implementation of a strategy to achieve that solution. The Declaration and the Programme of Action for a New International Economic Order adopted in 1974 and their subsequent elaboration at the seventh special session of the United Nations General Assembly and in the International Development Strategy for the Third United Nations Development Decade form the most comprehensive plan of action that exists at present.

The implementation of this strategy with deliberate speed is a vast undertaking, with commensurately massive requirements for resources and far-reaching implications for the structure and pattern of global economic activity. When new economic and social programmes requiring resources valued at several hundreds of billions of dollars are at stake, the resource constraints imposed by the arms race become apparent. It is even legitimate to wonder whether the adoption of such a bold and enlightened perspective is at all possible if international relations continue to be dominated by an arms race mentality. ■

If the nations were to place "their awareness of a shared future above their short-term ambitions and individual interests, the tremendous scientific and technological potential of the world could then be used more often to serve peaceful ends, promote the common welfare of mankind and help to forge relations based on justice and a sense of solidarity."

UNESCO NEWSROOM

Tribute to Paulo E. de Berredo Carneiro

Paulo E. de Berredo Carneiro, Ambassador of Brazil and a member of Unesco's Executive Board, died in his native city of Rio de Janeiro on 17 February 1982 at the age of 80. Ever since 1945, when he was Brazil's representative on the Unesco Preparatory Commission in London, he was closely associated with the Organization's most notable activities. He was chairman of the Executive Committee of the International Campaign to Save the Monuments of Nubia, and for many years directed the work of the international commission set up by Unesco to prepare the multi-volume *History of Mankind: Cultural and Scientific Development*. He was permanent delegate to Unesco for close on 20 years.

A man of science as well as a man of culture, philosopher and historian, a university teacher in Brazil and France, Paulo E. de Berredo Carneiro was a humanist who remained faithful to the culture of Latin America but also understood and championed all the values of the contemporary world, following their evolution with unceasing vigilance.

The philosopher who wrote *Towards a New Humanism*, published in 1970, was also a man of action. He contributed to the creation of a number of research institutions, notably the Brazilian Centre for Physical Research and the Brazilian Association of Education, expressing his belief in the association of science and education as the mainspring of culture. He firmly believed that a life devoted to the service of the international community was one dedicated to the highest ideals, and unfailingly affirmed his faith in tolerance, respect for others, and human dignity.

Cold from the sun

A method of harnessing solar power developed for the US space programme is to be field tested on a large scale in 13 countries to determine its effectiveness in fuelling refrigerators for vaccine storage and ice-making. The trial, which is backed by the World Health Organization and financed by the US Government, will begin this spring. The refrigerators to be tested use electricity generated by photovoltaic panels exposed to the sun.

The *Unesco Courier* in Bulgarian

We are happy to announce to our readers the launching of a Bulgarian language edition of the *Unesco Courier*. The Bulgarian edition, the first issue of which appeared in January 1982, is published in Sofia; its managing editor is Dimitar Gradev. This brings the total number of language editions of the *Unesco Courier* to 26, not counting the quarterly selection in Braille which is published in English, French and Spanish.

The growing scourge of TB

A century after the German physician Robert Koch discovered the tuberculosis bacillus the number of TB cases in the world is still increasing, although the means exist to eliminate the disease as a major health problem by the year 2000. The Director-General of the World Health Organization, Dr. Halfdan Mahler, writes in the current issue of *World Health*, the Organization's magazine, that "In the majority of developing countries there has been little or no improvement in the epidemiological situation. Between 4 and 5 million highly infectious cases emerge each year, and TB brings death to at least 3 million persons annually."

Death of Luther H. Evans, former Unesco Director-General

Mr. Luther H. Evans, Unesco's Director-General from 1953 to 1958, died on 22 December in San Antonio, Texas. Born in 1902, he was Librarian of the United States Congress from 1945 to 1953, and served as adviser to the US delegation to the London conference in November 1945 at which representatives of 44 nations signed the Unesco constitution. In 1947 Mr. Evans became a member of the US National Commission for Unesco, and its chairman in 1952. He played a particularly active role in the preparation of the draft Universal Copyright Convention, heading the US delegation to the Geneva conference in 1952 which culminated in the signing of the convention. In a telegram to Mrs. Luther Evans, Mr. Amadou-Mahtar M'Bow, Director-General of Unesco, expressed his sorrow at the death of his predecessor which had "deeply grieved all his former colleagues in the Secretariat which owes much to his wise leadership and to his exemplary commitment to the ideals of the Organization."

BOOKSHELF

Recent Unesco books

■ **Armaments, Arms Control and Disarmament,** A Unesco reader for disarmament education, edited by Marek Thee (See opposite page).

■ **Obstacles to Disarmament and Ways of Overcoming Them,** edited by Swadesh Rana. A contribution to Unesco's campaign to launch disarmament education during the Second Disarmament Decade proclaimed for the 1980s. 1981, 233 pp. (45 F).

■ **Unesco Yearbook on Peace and Conflict Studies, 1980.** Co-published with Greenwood Press, Westport, Connecticut, USA, who have exclusive sales rights in the USA and Canada. Edited by Dr. Hylke Tromp, director of the Polemological Institute of the University of Gronigen (Netherlands) and Deputy Secretary General of the International Peace Research Association. 1981, 311 pp. The first volume of a projected annual series. (175 F).

■ **Unequal Opportunities. The Case of Women and the Media,** by Margaret Gallagher. An overview of the situation of women in the media, their opportunities and possibilities of development in this field. 224 pp. (50 F).

■ **The Process of Educational Innovation,** An international perspective, by Raymond S. Adams with David Chen. A study on planned innovation and reform in education systems. Co-published with Kogan Page Ltd., London, who have exclusive sales rights in the UK. 284 pp (100 F).

■ **Organizing Educational Broadcasting,** by David Hawkridge and John Robinson. Co-published with Croom Helm Ltd., London, who have exclusive sales rights in the UK (100 F).

■ **Living in Two Cultures.** The Socio-Cultural Situation of Migrant Workers and their Families. Co-published with the Gower Publishing Co. Ltd., Aldershot, UK, who have exclusive sales rights in the UK (140 F).

■ **Why People Move. Comparative Perspectives on the Dynamics of Internal Migration.** A study on the causes and consequences of migration in developing countries. 344 pp. (60 F).

■ **Guide for the Collection of Traditional Musical Instruments.** by Geneviève Dournon with the collaboration of Simha Arom. 108 pp. (36 F).

■ **The Book Today in Africa,** by S.I.A. Kotei. 210 pp (32 F).

Other books

■ **Nuclear Radiation in Warfare; Arms Controls, A Critical Survey,** by Jozef Goldblat (available May 1982).

■ **World Armaments and Disarmament SIPRI Yearbook 1982** (available May 1982); **The Arms Race and Arms Control:** a paperback, which will be published annually, draws on material from SIPRI'S annual Yearbook of World Armaments and Disarmament (available June 1982); **Outer Space, A New Dimension of the Arms Race** (available June 1982). All published on behalf of Stockholm International Peace Research Institute (SIPRI) by Taylor and Francis Ltd., London.

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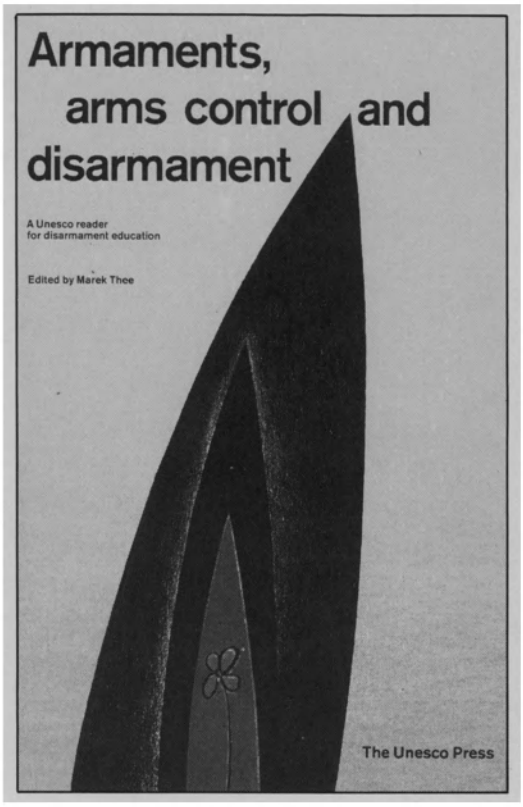

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